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NOTES FOR THE MONTH.

Prime Minister's Statement to the Agricultural Advisory Committee.

THE Prime Minister, who was accompanied by Mr. Noel Buxton, Minister of Agriculture and Fisheries, and Mr. Walter R. Smith, Parliamentary Secretary, received at 10, Downing Street, on 1st February, the members of the Agricultural Advisory Committee for England and Wales.

The Prime Minister said that he had invited them to see him in order to assure them that the Government was exceedingly anxious to tackle the agricultural problem, and that he regarded the condition of the industry as a national concern. While the Government had to rule out any hope of Protection or subsidies of the kind suggested hitherto, it was most earnest in its desire to be of every possible assistance in other directions, and a special Committee of the Cabinet had been appointed to examine the problem. The Government would welcome advice and guidance from practical men who knew the difficulties and who would make suggestions for placing agriculture on a sound, scientific and businesslike footing.

He added that he felt that the great contribution that the Labour Government could make to the solution of the question was that they would relate the problem of the country to the problem of the town, and that if the agricultural problem was treated as merely a farmers' or a farm labourers' one, and not also treated as a town problem, no solution at all would be arrived at.

Short speeches were made in reply by Mr. R. R. Robbins, Mr. George Edwards, M.P., Lord Ailwyn, Sir Douglas Newton, M.P., Lord Clinton, Mr. McLaren and Mr. McCaig, all of whom expressed the appreciation of the Committee at the invitation to meet the Prime Minister and their desire to assist

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the Government in regard to any measures which could be taken for the benefit of agriculture.

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Agricultural Credit Societies.

THE Minister of Agriculture, the Right Hon. Noel Buxton, M.P., in reply to a question in the House of Commons, made the following statement:—

"With the object of encouraging the formation of societies for the provision of short term loans to farmers under Part II of the Agricultural Credits Act, the Government have decided that advances to such societies should be made at bank rate varying—with a minimum of 4 per cent. Under present conditions this means a reduction of one per cent. in the rate of interest. I hope that farmers will realise the greatly increased advantages thereby offered under Part II of the Agricultural Credits Act."

This arrangement enables Agricultural Credit Societies formed under the Act to obtain advances from the Government at the current bank rate with a minimum of four per cent., and will enable the societies to lend the money at their disposal to their members at about one per cent. above bank rate.

A new leaflet has been prepared explaining the way in which credit societies can be formed and setting out the terms and conditions on which advances may be made to such societies. Copies can be obtained on application to The Secretary, Ministry of Agriculture, Whitehall Place, S.W.1.

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Loans to Agricultural Co-operative Societies.

THE Ministry of Agriculture is prepared to consider applications from agricultural co-operative societies for loans to enable them to develop forms of co-operation directed to the preparation and marketing of agricultural produce, such as bacon factories and milk depots. Provision will be made in the Estimates of the Ministry for the year 1924-5 for this purpose.

It will be remembered that the Departmental Committee on the Distribution and Prices of Agricultural Produce both in its various Interim Reports and in its Final Report strongly urged the need for State assistance to co-operative societies engaged in the sale, preparation or manufacture of farm products, by providing advances towards capital expenditure on buildings, land, plant or equipment. The Committee also recommended

the appointment by the Minister of Agriculture of a small Standing Advisory Committee to consider the merits of applications for advances, the Committee being constituted so as to include in its membership those possessing not only an extensive knowledge of agricultural conditions, but also some experience in finance and commerce. The Minister proposes to adopt this recommendation, and it is hoped that it will be possible to announce the composition of the Committee at an early date.

The exact terms and conditions on which the advances are to be made will be settled after consultation with the proposed Advisory Committee, but in order to enable societies to consider the matter without delay the following provisional conditions are given as an indication of the lines on which loans will be made:—

(1) The Ministry of Agriculture will make loans to agricultural co-operative societies registered under the Industrial and Provident Societies Act to the extent of such funds as may be placed at its disposal. In order that a society may be eligible for a loan the society must have for its object such agricultural purpose as may be approved by the Ministry, and its capital must be subscribed mainly by agriculturists. The share capital paid up by the subscribers must be not less than 5s. per £1 share, and the rate of interest on the paid-up share capital must be limited to 5 per cent.

(2) The amount of the loan from the Ministry will not exceed, in the case of a new society, half the total capital considered by the Ministry to be necessary for the proper equipment and working of the society, nor the amount of share capital subscribed by the members of the society, whichever may be less. No loan will be granted until the Ministry is satisfied that the remaining capital required for the proper equipment and working of the society will be available.

(3) Loans will only be made to existing societies for the purpose of improvement or extension of premises and plant, and the loan will not in any case exceed half the sum estimated to be spent on the improvement or extension of premises and plant.

(4) In no case will the Ministry's loan exceed the sum of £10,000 to any one society.

(5) In the case of a newly-formed society the loan will be secured by a first debenture upon all the assets (including uncalled capital) of the society. In the case of an existing society, it will be secured if possible by a first charge on the premises and plant obtained or improved with its assistance. If such a first charge cannot be given the Ministry will require other satisfactory security.

(6) Interest will be charged on the loan at 5 per cent. per annum, and the loan will be repayable in instalments spread over a period not exceeding twenty years. Both interest and repayment of principal will be payable half-yearly. The first payment in respect of both interest and principal, may if the society so desire, be deferred for thirty months after the date when the loan is actually paid over by the Ministry, or, if the loan is made in

more than one instalment, thirty months after the date when the first instalment is paid. The first payment to the Ministry will be six months' interest on the whole amount of the loan and a proportion of the principal according to the period of the loan. When the first payment is deferred as suggested above, the repayment of the interest and of the principal will need to be adjusted so that the whole loan is repaid within a period not exceeding twenty years from the date when the loan is first made.

(7) The Ministry must reserve the right to require at any time immediate repayment of the principal of the loan and all outstanding interest, but there would be no intention to exercise this right so long as the Society was managed to the satisfaction of the Ministry. The Ministry will also have the right, if it so desires, to appoint, either temporarily or permanently, a representative on the Committee of Management of any society to which a loan is made.

(8) The society shall cause an audit of accounts to be made yearly, and a copy of the auditor's report and of the accounts shall be supplied to the Ministry. The books of the society shall be open to inspection by an officer of the Ministry at any time.

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Foot-and-Mouth Disease: Statement by the Minister.

THE Minister made a statement in the House of Commons on the 18th February on foot-and-mouth disease, from which the following extracts, dealing with the slaughter policy, and with research, are taken :—

The slaughter policy has been called into question and very naturally is a subject of great public interest. The Ministry has maintained the policy of eradication by the immediate slaughter of all infected animals. That policy was subjected to an exhaustive review two years ago by a Committee of which Mr. Pretyman, formerly Member for Chelmsford, was Chairman, and that Committee reported on the whole strongly in favour of the policy. Owing to the highly infective nature of the disease, isolation has, as a rule, been adopted only in a few cases of pedigree stock of very high value. Prior to 1922 the slaughter policy was very successful, and the average annual cost to the Exchequer for several years before 1922 was £9,000 a year. On the Continent, where the disease is endemic, isolation has been adopted of necessity—it would be impossible to stamp out foot-and-mouth disease in most Continental countries—and the annual loss, for instance, in France, is said to be about £5,000,000, and in Holland the amount lost is estimated at £2,500,000. Despite the heavy cost which the slaughter policy involved two years ago and the still greater cost now, it has never been in question

whether the policy of mere isolation is not a failure compared with our policy. I have thought it over carefully, and in order to get a complete review of the situation I have asked Mr. Pretyman to preside over a Committee which will consist of some other gentlemen, as well as himself, who were members of the former Committee—the Parliamentary Secretary to the Ministry, Mr. H. German and Mr. Alexander Batchelor. I have asked them not merely to review the whole situation and the procedure adopted, but to go again into the comparative results and to state their opinion between one policy and the other.

It is very important to realise that this country, being an island, is capable of getting clear much more easily than other countries. Experience also shows that the results of slaughter have given satisfaction in the United States, Canada, Australia, New Zealand, Norway and Sweden. The United States had the disease and they eradicated it by slaughter at an expense of £1,500,000, since when they have been entirely free. In the same way, rinderpest has been completely stamped out in this country, as well as other diseases which we hardly hear spoken of now, but which some of us remember to have been very common.

If the disease were to become established and endemic here, as it almost certainly would become if isolation were adopted, among the subsidiary results would be the serious effect upon our export trade which we all know is a highly valuable item. Isolation not only requires too elaborate an organisation to be effective, but even in the few cases in which it has been adopted recently it has been very difficult to control the spread of the disease, and some cases have been freshly infected on premises on which isolation had taken place. The buildings on most farms are quite unsuitable for isolation, and you would require something much more elaborate to make the system a real success. Up to now we have the opinion of the majority of British agriculturists in favour of the slaughter policy, and during the present attack both the Council of Agriculture for England and Wales, and the Statutory Agricultural Advisory Committee, have approved of the policy of the Ministry. Another important consideration is that Great Britain has had extraordinary success with the policy in the past, and that the difficulty of isolation would be greater here than elsewhere because of the much greater stock of sheep in this country. Other countries have a much lower stock of

sheep, and we have an unusual area of pasture on which sheep run together and on which it would be impossible to carry out any effective isolation.

One other subject remains on which I would like to say a few words, and that is the question of research. Research, to my mind, presents the only aspect of interest and satisfactory work on which we can dwell with pleasure in connection with animal disease. There is very magnificent work done at the laboratories of the Ministry, and at many laboratories, some of which the Ministry assists with money, up and down the country. The possibility of such a visitation recurring, to my mind, necessitates much greater attention being paid to research, both into the causes of the epidemic and also into the possible means of immunising stock against infection. The idea has prevailed hitherto that we were putting our foot upon the disease, and, therefore, research did not receive very serious attention in this country till a few years ago. Prior to 1920, I find, there was no particular investigation because of the extreme danger of spreading the disease. In 1912, a Commission was sent to India, with instructions to begin the investigation of the origin and means of transmission of the disease, but they found it was impossible to make any satisfactory progress with their studies because of the universal prevalence of the disease in a mild form, so that animals for experiment could not be found that were either free from the disease or not to some extent immune from it.

Following that, in 1920, a Committee was appointed, under the Chairmanship of Professor Muir, of Glasgow, which made investigations into the artificial cultivation of the virus and into the visibility of the microbe, the bacillus, but no success has as yet been met with in that respect. The Committee established a laboratory at Harwich, they asked the Admiralty for a disused warship, they anchored two lighters, on which the animals lived, alongside this ship, and for seven months they carried on research, but at the end of that time they came to the conclusion that it could not be profitably carried any further. The number of animals was too limited, there was great difficulty in maintaining a supply of virus, and another trouble has been that the virus, when brought from a distance, loses its virulence with great rapidity, and most variably and unexpectedly. The pathologists in charge failed to discover within the period any method of cultivating the virus, and the Committee con-

cluded that they had better stop, unless it could be continued on a much larger scale, preferably on an island. They spent £13,000 on that piece of work.

For many years there has been continuous and organised investigation by the efficient veterinary staffs of countries where the disease prevails widely, such as France, Germany, Switzerland, and Holland, and in spite of all that, the greatest difficulties have been met, owing to the fact that the virus is ultra-microscopic. This is a general question of interest, not only in connection with foot-and-mouth disease, but scientists all over the civilised world are working at this matter of visibility or ultra-invisibility, and when that has been advanced, foot-and-mouth disease, with other diseases, will be dealt with with far greater ease. There is work being done all over the world on what is really the basis of research, but so far these investigations have not succeeded. They have not cultivated the organism, and they have not found a vaccine. Quite lately, a German investigator was said to have made a very great advance, and the German Government gave permission for him to discuss the matter with one of our representatives. One of our officials has been sent, and we are hoping for his report.

There are experiments being carried out under the Ministry's chief veterinary officer, and we are examining the possibility of further investigations. Sir Robert Sanders referred the question to the well-known scientist, Sir William Leishman, as to the proper sphere of inquiry, and I propose to appoint a Committee, consisting of both veterinarians and human pathologists, with instructions to frame a scheme of investigation, and then to allocate to each branch of it the particular individuals who are most suitable, the Committee to supervise and to co-ordinate the results. That will cost money, and we have obtained the consent of the Treasury for a sum sufficient to carry on that work for some years. We cannot anticipate that this very difficult inquiry will come to an end for a very long period. It might be several years before any adequate results were obtained. I think we may hope that such an exhaustive inquiry may lead to very valuable results, which have never been gained in this country up till now. I think that is all I had better say now. It seems to me that from this very sombre subject one very fine thing emerges, and that is the unremitting work done by those concerned with the outbreaks, and the untiring labours connected with the research which has already been carried out.

National Stud.

MR. LAMBERT asked the Minister of Agriculture in the House of Commons on 18th February what were the capital costs in buildings and other expenses incurred in the taking over of the national racing stud; whether such sums were paid out of borrowed money; what have been the financial results of Government racing during the past year; and whether it is intended to continue this pastime at the taxpayers' expense.

In reply, Mr. Buxton stated that the national stud was established in 1916, primarily on military considerations, as the result of the gift to the Government by Lord Wavertree of his valuable thoroughbred stud, together with all the live and dead stock on his Tully estate in Kildare. The owners' and tenants' interests were purchased for £47,625 by means of a Vote of Parliament. The stud is maintained as a breeding, and not a racing, establishment, and there is an accumulated trading profit up to 31st December, 1922, of £33,550. There is no reason to think that the trading account for last year will not, also, show a profit. It is intended to maintain the national stud, and, it is hoped, to the continued benefit of the taxpayer.

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Heavy Horse Breeding Grants.

IN reply to a question in the House of Commons on the 19th inst., the Minister of Agriculture stated that he had carefully reviewed the circumstances of Heavy Horse Societies in relation to the Ministry's Live Stock Improvement Scheme, and was satisfied that the withdrawal of grants to those societies in 1922 had discouraged co-operation among farmers in the hiring of stallions, and had otherwise proved detrimental to the heavy horse breeding industry; he had, therefore, decided to restore the grants so far as direct subsidy to a society is concerned.

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Agricultural Wages.

IN reply to a question in the House of Commons on 20th February as to the date when legislation would be introduced to give effect to the Prime Minister's promise with regard to the setting up of a wages board and legal minimum wage for agricultural workers, the Minister of Agriculture said that he was not yet in a position to state when it would be possible to introduce legislation to deal with the question of agricultural wages, but every effort was being made to press forward with this question, and he hoped that he would be able to submit his proposals to the House at an early date.

The Agricultural Index Number.

THERE was a further marked advance in the general level of prices of agricultural produce in January, the average increase over the corresponding month in the years 1911-13 being 61 per cent., compared with 56 per cent. in December. There has been a continuous rise since October, but the figure is still lower than at this time last year.

In the following table are shown the percentage increases monthly since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911-13.

MONTH.	1920.	1921.	1922.	1923.	1924.
January ...	200	183	75	68	61
February ...	195	167	79	63	—
March ...	189	150	77	59	—
April ...	202	149	70	54	—
May ...	180	119	71	54	—
June ...	175	112	68	51	—
July ...	186	112	72	53	—
August ...	193	131	67	54	—
September	202	116	57	56	—
October ...	194	86	59	51	—
November	193	79	62	53	—
December	184	76	59	56	—

Although the advance in wheat prices which occurred during November and the first half of December was interrupted towards the close of the latter month, a recurrence of the rise in January caused a further slight advance in the index number. Oats also advanced further, while barley realised somewhat higher prices in January than in December, an unusual feature at this season. The index numbers for the three cereals are, on the whole, keeping very close together, and all show a decided advance since the opening of the cereal year.

The most prominent feature of the month of January was the rapid advance in potato prices. During the last two months of 1923 prices at the wholesale markets rose by nearly £1 per ton, while January prices averaged nearly £2 per ton more than those of December. Potatoes are now considerably more than twice their pre-war price, a striking contrast with the position in January of last year, when wholesale prices were practically at pre-war level. No marked shortage has been experienced in the markets, and the recent advance in prices is probably in part due to anticipation of and actual effects of the railway strike in relation to the much smaller crop of 1923. Potatoes are estimated to represent normally about one-twentieth of the total annual sales of produce off farms in this country, and two points out of this month's rise of five points

in the general index number are thus accounted for by the increase in potato prices.

Fat cattle and sheep advanced in price in January, contrary to the usual fall after the Christmas trade, but pigs were cheaper, although the decline was relatively no greater than normally occurs between December and January. All classes of fat stock, however, and especially pigs, are cheaper than at this time last year, when both sheep and pigs were exceptionally dear.

So many markets are closed to store stock at present that average prices of dairy cows and stores are not thoroughly representative of trade throughout the country. The figures quoted in the table given below indicate, however, that store cattle and sheep are dearer, but that store pigs are cheaper, probably in sympathy with conditions in the trade for fat pigs.

Apart from these changes, there has been little noticeable alteration during the month. Poultry, after experiencing a dear Christmas trade, has relapsed to about the November level, 60 per cent. above the average pre-war prices. Eggs remain comparatively dear at 85 per cent. above the price in the corresponding month in 1911-1913, while dairy produce shows comparatively little change on the month; cheese is 1s. 6d. per cwt. cheaper, but this fall is less than normally occurs at this season, and the index number shows an advance of 5 points. No appreciable improvement in hay prices can be recorded.

The following table shows the average increases during recent months and in January, 1923, in the prices of the principal commodities:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.					1924.
Commodity.	Jan.	Sept.	Oct.	Nov.	Dec.	Jan.
Wheat ...	33	19	20	22	33	34
Barley ...	20	30	25	25	27	34
Oats	43	30	25	24	30	38
Fat cattle ...	61	45	44	47	49	56
Fat sheep ...	108	72	76	77	72	87
Fat pigs ...	102	55	48	47	43	43
Dairy cows ...	74	52	61	57	—	51
Store cattle ...	36	27	27	25	—	35
Store sheep ...	105	109	99	88	—	91
Store pigs ...	171	95	82	75	—	62
Eggs... ...	86	75	92	92	86	85
Poultry ...	81	67	65	58	77	60
Milk	90	67	72	75	90	87
Butter ...	73	56	61	64	68	68
Cheese ...	85	74	76	73	71	76
Potatoes ...	—1*	75	62	80	91	129
Hay	43	32	7	—1*	0	—1*

* Decrease.

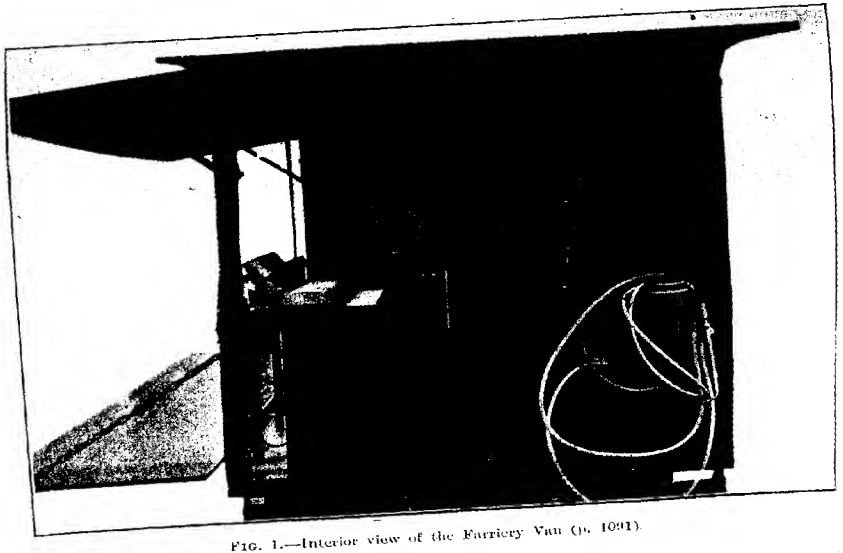

FIG. 1.—Interior view of the Farriery Van (p. 1091).

A Travelling Farriery Van.

An interesting experiment is now being conducted in Oxfordshire by the County Agricultural Committee. Some time ago the Rural Industries Intelligence Bureau carried out a survey with regard to rural industries in the county of Oxford. As the result of the report of Mr. Elkington, the Secretary of the Bureau, who carried out the survey, it was decided that some attention should be devoted to assisting blacksmiths throughout the county, by demonstrating how their trade could be expanded in the direction of general metal and repair work, by the use of simple machinery.

With the sanction of the Treasury a sum of money has now been provided from the Development Fund, which has enabled the Ministry to purchase and equip a travelling van which will be available for loan to different counties, Oxford having been selected in the first instance. The van will be in charge of the Farriery Instructor attached to the County Agricultural Committee, who will tour from village to village with the object of affording instruction to as many blacksmiths as possible by means of the special machinery installed in the van. The photograph shows the interior of the van. It may be mentioned that the chassis is that of a 4-ton lorry, purchased at the Slough Depot, with a standard pattern War Office workshop body as used in the War. It has been specially equipped with an oxy-acetylene welding plant, emery grinding and drilling machines, lathe, work bench, and vices, and a serviceable outfit of small tools and accessories. Power for driving certain of the machines installed is supplied by a small 1½ B.H.P. oil engine. The equipment of the vehicle has been in the hands of the Rural Industries Bureau, and the actual fitting up of the workshop has been carried out by the Government Instructional Factory for disabled men at Cricklewood, whose services have been available through the courtesy of the Ministry of Labour.

By kind arrangement of the Manager of the factory, the van was inspected on 29th January by representatives of the Ministry of Agriculture, the War Office, the Home Office, Board of Trade, Development Commission, the National Master Farriers' and Blacksmiths' Association, the Bureau, and the Press. The Director of Agriculture for Oxfordshire and the county farriery instructor were also present. All expressed themselves as highly satisfied with the equipment of the van.

The van will start its tour in Oxfordshire at an early date.

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AGRICULTURAL POLICY OF THE GOVERNMENT.

IN his statement in the House of Commons on 12th February, the Prime Minister referred to agriculture as follows:—

We come to agriculture. In agriculture we have a subject of the most pressing national interest. I have not shared the views of the agriculturist who said the industry was on its last legs. There is plenty of evidence to show that is not the case. A great fault committed by those fellow-citizens of ours who are always telling us they are on the brink of ruin is that they always live from season to season. When a good season comes they say nothing about it. When a bad season comes all they do is to produce to their own minds and to us the figures of the bad season and try to convince us that that is a normal and average condition of the industry in which they are engaged. Far from it! There is not the least doubt about it that even now careful book-keeping on the part of large numbers of farmers does not exist, and one of the services now being given by the Ministry of Agriculture to the farming industry is to supply them with professional gentlemen who can tell them how to keep books and accounts with sufficient accuracy to enable them to see how their business goes from year to year. There are some other schemes that must receive immediate attention.

There is, for instance, the question of rating—not necessarily agricultural rating, but the whole question of rating. Government after Government has promised to deal with this subject, and I have not the least doubt has tried to deal with it, but has failed to do it. The Labour Government is going to make an attempt. The whole question of rating is due for revision, not for farmers, but for everybody. The Government proposes to bend its attention to this subject and hopes, with a fair amount of luck—before it will be time for it to leave these benches and either transfer to those opposite or go to the country—it will have produced its scheme for readjustment and reform. No interest in the country would benefit more from a rating based on scientific principles than the agriculturist, the farmer who is farming his land, and who is not going to be charged with rates for improvements upon it.

So far as we are concerned we shall not touch tariffs nor bounties. Both tariffs and bounties are wrong. They only help to encourage inefficiency. They induce the towns to

regard agriculture as something that preys upon them. They cannot be confined to agriculture and agricultural produce alone. Bounties in particular, and also tariffs—but bounties in particular, must be attended by an oppressive control, for no Government in its senses would ever make large presents of public money to an industry and then say to that industry: "You can carry on your work in any way you like." Control of the most definite, detailed, and most oppressive kind must accompany any system of bounties given to farmers. I am perfectly certain that, under these circumstances, farmers would not agree to it.

What agriculture requires is a stimulus to fight its own battle. I was talking to an eminent agriculturist only the other day and a remark he made to me was this: "If we could get all our agriculturists to farm as efficiently as the 20 or 25 per cent. at the top there would be very little agricultural problem in this country." That is the spirit and the line upon which the Government propose to work, and, therefore, we select co-operation as the best means for aiding, developing, and stimulating the agricultural industry.

The Government propose to support, either by loans or by guarantees, co-operative enterprises controlled by the agricultural community, organised and directed mainly to deal with agricultural produce, the buying of the raw materials, seeds, manure, the buying of implements of cultivation, the supplying of markets, and all those processes necessary to make agriculture a paying and prosperous concern in this country. The Government feel perfectly convinced that all extraneous aids to agriculture are only likely to result in a further deterioration of the agricultural mind, and an increased tendency and process on the part of farmers to trust to the power of the State and their influence in Parliament to get doles from the public purse, instead of solving their own problems by applying their own energy. The organisation of farmers' co-operative enterprises by farmers working as a function of the community, founded, encouraged, extended by State credit is a form of individualism which the founders and the defenders of individualism would not know from Socialism.

In connection with the idea of stimulus, the Government propose to set up again the Wages Boards. In some parts we are informed wages are again falling below the 25s. a week minimum. How any farmer can imagine that he is going to get value from a labourer whose income in these times is

under 25s. a week I do not understand. [AN HON. MEMBER: "He does not!"] Well, if he does not, the stimulus to compel him to regard labour as the first charge on industry will enormously improve him as a farmer and increase the efficient cultivation of his land. There is nothing that is more uneconomical, even on bad land, than sweated labour, and by the re-establishment of Wages Boards, which will work in districts, we will create a stimulus which, instead of being more hampering to the farmer, will compel the farmer to use more efficient expedients than he has used hitherto in order to make good use of his labour and land. The whole point is this—and this is the general idea of the Government—that until we get the farming community stimulated to organise itself and to function as it has done, in Denmark, for instance, then nothing else is going to be of real and substantial benefit to the agricultural community of this country.

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CO-OPERATIVE LIVESTOCK MARKETING IN THE UNITED STATES.

SINCE the end of the War, great progress has been made in the United States by livestock producers in the development of co-operative agencies, known as "shipping associations," for the purpose of replacing the ordinary buyer in the business of forwarding livestock to market.

These co-operative associations were primarily brought into being in consequence of the operating margins of stock dealers being considered excessive. The first associations of the kind were formed as far back as 1872, but it was not until 1916, in the middle of the War, that the movement began to assume large proportions. At the present time, there are said to be as many as 3,800 of these "shipping associations" in the United States.

The early organisations of this kind were formed as part of what was known as the Granger movement, and were followed by associations such as the Goodlettsville Lamb Club—a co-operative agency which graded and pooled lambs and wool, and sold them by auction. When favourable bids were not secured, the club shipped its products to central markets. This club has continued to operate since 1877, and a number of similar clubs have been organised in recent years on the same lines. In 1908 a "shipping association" at Lichfield, Minnesota, was inaugurated, and proved to be the beginning of a wide development in the co-operative selling of livestock in that district.

The year 1916 saw a very rapid rise in the general price level in the United States, and stock producers experienced an unwillingness on the part of local buyers to follow the rising markets, and to give an adequate price for animals, and they, accordingly, fell back on organising co-operative machinery to replace them. This resulted in the formation of a large number of livestock shipping associations. The scope of these associations is small, since they do not attempt more than the assembling of livestock in car-loads at country points, and forwarding it to central markets. Moreover, they have adopted the principle of co-operation only to a small extent. There is usually no pooling either of produce or profits, all receipts, after the cost of transport and handling have been paid, going to the owners of the stock. What success has been achieved by these societies is due primarily to the fact that they have been able to work on a narrower margin than the ordinary buyer, and it is claimed that in this way they have succeeded in substantially reducing the costs of marketing and distribution.

A more important co-operative movement in connection with livestock is the formation of commission agencies, the genesis of which may be roughly described as follows:—

During the nineteenth century, there was a gradual concentration of the meat packing industry in Chicago, and along with this development, Chicago became the central livestock market, and tended largely to govern prices in other markets. In a similar way, the large meat packing firms have come to dominate the packing industry, and to handle the bulk of the meat slaughtered at the principal markets.

Originally, the packers bought direct from the owners, or from country buyers. The practice gradually grew up, however, for expert salesmen to act on behalf of those who knew little of livestock values, and from this, the livestock commission business was developed. Commission merchants at each market are organised into fairly close associations or exchanges, and these exchanges, in the course of time, became powerful enough to exclude from the market all business except that which passed through the hands of recognised commission agents.

Attempts on the part of producers to organise co-operative selling agencies of their own, met with little success until 1916, largely on account of the strong opposition of the livestock exchanges. Since that year, however, co-operative commission associations have progressed very rapidly, and on 1st January, 1923, such agencies are stated to have been established in thirteen of the principal livestock markets in the United States.

An important example of a co-operative commission agency is afforded by the Farmers' Union Livestock Commission. It was started by the Nebraska Farmers' Union, and the plan was to operate a livestock selling agency on the South Omaha market, without capital stock, which would charge the prevailing commission rate, and at the end of each year would pay all profits to shippers in the form of a "patronage dividend." An application by this organisation to the South Omaha Exchange was, as might have been expected, rejected. But the Commission started business independently, and after operating for some months at a loss, it eventually secured a considerable amount of business. At the end of the first year, the Commission handled over 2,000 car-loads, during the second year over 5,000, and in 1921 the business had increased to 7,700 car-loads.

Following upon the success of this agency, the Nebraska Farmers' Union organised similar bodies elsewhere, and were responsible for setting up three livestock selling agencies organised as joint stock companies.

One of the most remarkable of the co-operative livestock organisations is that developed at St. Paul's. The Central Co-operative Commission Association established at this market differed from other ventures of a similar character, in being founded upon local livestock shipping associations. Over 200 livestock shipping associations had become members of the Central Association at the time it started selling operations in 1921. The growth of this organisation was remarkable. Starting in August, 1921, by December it had received over 4,000 car-loads, and had become the chief agency in the market. In August, 1922, its business had amounted to approximately 13,000 car-loads, and the value of the animals sold during the preceding year amounted to over 17,000,000 dollars. The Association's chief success was, however, in the great saving effected for shippers. Not only did it charge a rate of commission 25 per cent. lower than the other exchange firms, but it made large profits which were distributed amongst its members in the form of patronage dividends. The total savings in commission alone, including both the 25 per cent. lower rate and the surplus trading profits distributed as dividend for the year 1922, were stated to be as much as 60 per cent.

By reason of its prominent position in the St. Paul's Livestock Market, this association succeeded in securing during 1922 a measurable degree of stabilisation of livestock prices in this

market. To quote Mr. Steen,* "In former years, St. Paul's quotations fluctuated more violently than did other markets, but beginning about the time the Central† reached the 25 per cent. stage the market lost many of its former wild antics. It was pushed up closer to Chicago hog prices than had been the case for years, and remained there all spring and summer, with the difference that its fluctuations were less violent. The net advantage to producers from this stabilisation is great; the heavy runs of livestock are nearly all accompanied by lower prices, while the market is usually rather bare when sharp advances occur."

It remains to consider how far the principle known in the United States as "orderly marketing" or "merchandising," has been applied to the sale of livestock. In this connection, the most important development has been in the organisation of the National Livestock Producers' Association, and its affiliated commission associations, under the auspices of the American Farm Bureau Federation.

The movement was initiated in 1920, when a National Livestock Conference was held in Chicago. The Conference recommended the appointment by the American Farm Bureau Federation of a Committee of Fifteen, to develop plans for the co-operative marketing of livestock. This committee produced a scheme which was approved by a National Conference of Livestock Organisations in Chicago, in November, 1921, based on the following points:—

1. The formation of co-operative commission associations at each of the principal terminal livestock markets, each with subsidiary "stocker and feeder companies": these associations to be based both on individual membership of producers, and on membership of shipping associations.
2. The general development of co-operative livestock shipping associations along lines approved by the chief farm organisations in each State.
3. The organisation of the National Livestock Producers' Association as an overhead supervising agency, charged with the duty of perfecting an orderly flow of livestock to market.

In other words, this committee recommended the federation of Commission Agencies for the purpose of securing orderly marketing and the stabilisation of market prices, on the lines

* "Co-operative Marketing. The Golden Rule in Agriculture," by Herman Steen, from which most of the facts in this article have been drawn.

† i.e.—The Central Co-operative Commission Association.

which had proved so successful in other branches of co-operative marketing in the United States (see article in this *Journal* for January, 1924). The first efforts were directed towards the organisation of commission associations, and six of these were established in different livestock markets during 1922. In each case they developed rapidly until they became the chief agencies in their respective markets. All these commission agencies are organised according to a uniform plan. They are non-stock and non-profit associations. Membership fees are charged for each livestock shipping association, and the affiliation of a shipping association automatically makes each individual farmer a member of the commission association and the National Association, without additional fees. There is no contract, though it is assumed that no shipping agency would join it unless it expected to consign most or all of its stock to the commission association. The commission associations handle non-members' stock in the same way as members', except that, in such cases, no patronage dividends are paid. Each commission association has a subsidiary organisation which makes purchases of "stockers and feeders" on order, buying wherever it can to the best advantage. The commission association is governed by a board of seven or more directors which supervises its activities, while the National Association has a board of nine directors, to which is added a representative from each terminal association as it is organised, the headquarters of the National Association being in Chicago.

Up to the present, the development under this National Association has obviously not proceeded far enough to bring about an effective control over the movement of livestock to market, but the important point is that it has formed an organisation on the now well-established principles of co-operative marketing in America, which, when developed on a larger scale, will give to producers greater powers of controlling the marketing of their produce, and preventing undue fluctuation in livestock prices. At the moment it is clear that producers are only taking the first steps in co-operative livestock marketing. There would seem, however, to be every reason to expect a rapid development of the movement on the lines laid down by the Committee of Fifteen.

LUCERNE.

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LUCERNE or Alfalfa (*Medicago sativa* et spp.) is a native of south-west Asia, wild forms also occurring in China and Siberia. It has been recognised since ancient days as a valuable fodder plant, and is now grown for "green fodder" and hay in most parts of the world—in some countries on an extensive scale.

In 1885 the area under Lucerne in England and Wales was 13,954 acres, by 1894 it had increased to 20,000 acres, during the ten-year period, 1894-1904, the area rose to 55,700, and by 1913 it had further advanced to 57,278 acres, and in 1923 to 57,900 acres.

Lucerne is chiefly grown in the eastern, south-eastern and midland counties of England, the only western counties growing appreciable amounts being Gloucestershire, Wiltshire, Herefordshire, Shropshire and Glamorganshire in Wales, not one of these counties, however, contributing as much as 1,000 acres to the total area.

The restricted area on which Lucerne is grown in this country, although largely due to soil and climatic conditions, is probably also in part due to a lack of appreciation of the many and important uses to which the crop can be put.

Value as Green Fodder.—Perhaps the outstanding merit of Lucerne is that, given favourable conditions and proper care, it has the ability to remain productive over a greater number of years and to produce a larger bulk of nutritive fodder per annum than any forage plant in general use. Thus on leys in Sweden Lucerne has given an average of 15 tons of green fodder per annum over a six-year period, and in this country and elsewhere leys are frequently competent to remain fully productive for ten years or even longer.

An important advantage of Lucerne is its ability to remain productive under conditions of drought, in which respect it far surpasses red clover. Thus in a dry year the total yield from a Lucerne ley cut three times may be more than double that from a red clover ley, while in a wet year the red clover may give slightly the heavier crop.

Lucerne has long been recognised as a fodder of particularly high feeding value. Feeding experiments conducted for milk production at Wooster, Ohio, have shown that Lucerne appears

to be a better appetizer than red clover, but if samples of hay of red clover and Lucerne are of equal quality they are about of equal value for milk production; the superiority of Lucerne over red clover appears to turn not so much on its undoubted higher protein content as upon the greater bulk that can be produced per acre over a number of years.*

An important point in favour of Lucerne is, of course, its general utility—serving alike for the production of hay, silage and soiling.

In recent times it has come to be regarded as an excellent feed for pigs, while it has long been recognised as an admirable feed for horses, Rodwell in 1842 advising every farmer who can grow Lucerne to devote an acre of the crop to every four horses.†

In this country the view is generally held that Lucerne is not suitable for pasturage—thus at the Ministry's farm at Methwold it has been found, no matter what precautions are taken, that there is grave risk of the animals becoming "bloated." It should be remarked, however, that Lucerne is largely used for grazing in the Argentine, and an interesting account is given by McGillivray of successful pasturage in North Canterbury, New Zealand, by sheep.‡

The beneficial effect of a good Lucerne stand on the subsequent fertility of the land is a further consideration not to be overlooked, and has been well shown by experiments conducted at Rothamsted and in North America and elsewhere.§

Varieties and Nationalities.—Lucerne as ordinarily understood in this country is the blue-flowered species (*Medicago sativa*) which is a tall (about 2½ feet), erect, many-branched perennial with a deeply-penetrating tap-root. The yellow-flowered species (*M. falcata*) has a more branched and spreading habit, a less deep-going and more spreading root system, does not as a rule set seed as freely as ordinary Lucerne, and, largely in consequence of this last defect, can at present hardly be regarded as an important commercial commodity. A number of varieties also occur which are hybrids, having originated from crosses between *M. sativa* and *M. falcata*.

* See Hayden, C. C.: "Clover or Alfalfa for Milk Production," Ohio Agricultural Experimental Station, Bull. No. 327, 1918.

† Rodwell, J.: "On the Cultivation of Lucerne," Jour. Royal Agr. Soc., Eng., Vol. III, 1842, p. 239.

‡ Mc. Gillivray, R.: "Pasturing Lucerne," New Zealand Journal of Agriculture, Vol. XXII, 1921, p. 93.

§ See, *e.g.* Report for 1918–20: Rothamsted Experimental Station. See Buffum, B. G.: "Alfalfa as a Fertilizer," Wyoming Agri. Exp. Station, Bull. No. 43, 1900.

The varieties and nationalities have been extensively studied by Witte and others in Sweden, and by Oakley and Westover and others in America, and it is only necessary here briefly to refer to those which appear to be suitable for use in this country.*

Provence, Spanish, Italian and Hungarian.—Trials conducted over a seven-year period by Messrs. Sutton and Sons of Reading,† have shown Provence superior to Spanish and Italian as 100 is to 95.3 and 90.4 respectively; while at Aberystwyth Provence compared to Italian as 100 to 60. These trials confirm the view generally held that of the ordinary European nationalities of Lucerne grown in this country Provence is the most reliable.

Hungarian Lucerne has, however, done very well in Sweden, and is stated by Elofson to be the best of the ordinary types for use in that country, giving yields of 20 or 30 per cent. higher than French, Spanish or Italian. In view of the fact that so many Swedish varieties of oats succeed well in Britain it would seem therefore that Hungarian Lucerne deserves extended trial.

American and Turkestan.—These nationalities are largely grown in America and have been tried from time to time in this country. Messrs. Sutton's trials appear to indicate, however, that they are not at all well suited to our conditions.

Grimm.—This is the best known variety of the hybrid (often known as variegated) Lucernes. Extensive trials conducted in the States since 1905 have shown true Grimm to be one of the hardiest of Lucernes in so far as resistance to winter killing by frost is concerned, and it is now extensively grown in Minnesota, Montana, Idaho and the Dakotas.‡

* For important details as to varieties and nationalities see the following papers:—

Witte, Hernfrid: "Blåluzernodling," Göteborg, 1912.

Witte, Hernfrid: "Amerikanska blåluzern stammar, Grimm och Cossack vid försök i Sverige," Sveriges Utsädesförenings Tidskrift, 1922. p. 267.

Elofson, A.: "Anbau und Pflege der Luzerne," Jahrbuch der deut. Land. Gesellschaft, Vol. 35, 1920, p. 1.

Oakley, R. A. and Westover, H. L.: "Commercial Varieties of Alfalfa," United States Department of Agriculture, Farmers' Bulletin No. 757, 1916.

† See Sutton's Farmers' Year Book and Graziers' Manual for 1921.

‡ For further particulars as to Grimm and other variegated Lucernes see the following papers:—

Brand, C. J.: "Grimm Alfalfa and its Utilization in the North-west," U.S. Department of Agriculture, Bureau of Plant Industry, Bull. No. 209, 1911.

Westgate, J. M.: "Variegated Alfalfa," U.S. Department of Agri., Bureau of Plant Industry, Bull. No. 169, 1910.

Oakley, R. A.: "The Seed Supply of the Nation," Separate from Year Book, U.S. Dept. of Agri., 1917, No. 757.

Witte, "Amerikanska....." 1922, *loc. cit.*

Recently, renewed attention has been given to the variegated Lucernes in Europe, and Witte states, as the result of trials conducted at Svalöf, that genuine Grimm is quite comparable with Hungarian at any rate in first and second year leys (the duration of his trials at the time of reporting), and that should it prove to be persistent it might be presumed to be suitable for those parts of Sweden where often only two cuts can be made. Witte's data show that Grimm has out-yielded Hungarian in gross yield from six cuts in two years in the proportion of 100 to 98, whilst Hungarian has out-yielded Grimm in the sum of the third cuts only for each year in the proportion of 100 to 78. It is very significant that in Sutton's trials above referred to, over a seven-year period Grimm has yielded as heavily as Provence, and to find that Provence has shown to the best advantage during the first three years, but that in the seventh year Grimm has given decidedly the heaviest yield.

An indication of the hardiness of Grimm in comparison with Provence has been obtained from the Aberystwyth trials. In the case of a trial of Lucerne sown in drills in 1921 certain drills were cut monthly during 1922, and for the five months May-September the gross yield of these five cuts given by Provence was twice as great as that given by Grimm. The same drills were again cut monthly for the five months April-August, in 1923 (second harvest year) when the yields were in favour of Grimm in the proportion of 100 to 61, thus showing that Grimm had resisted this severe treatment better than Provence to a remarkable degree.*

It would appear from the above facts that Grimm is a variety that should be further tested in this country particularly in districts where it is difficult to establish a long-duration Lucerne ley, and in cases when it is not desired or practicable to take more than two or three cuts in any one season.

Selection of Field.—To succeed well, Lucerne requires fertile conditions. The soil, and perhaps to a greater extent the subsoil, should be suitable. It does best on clayey or sandy loam of good depth—with a well-aerated subsoil. Lucerne can only be grown successfully on stiff clay if this is well drained.

Lucerne requires a fairly high proportion of lime in the soil, since it is a plant which appears to make greater demands

* It is evident from investigations in progress at Aberystwyth with various herbage plants that ability to withstand severe and oft-repeated cutting affords a valuable indication of a plant's ability to persist.

on this substance than most other crops—consequently, lime, as such, is necessary to Lucerne, irrespective of its ameliorating influence on soil acidity and soil condition.

Particularly in regions of high rainfall fields with a sufficient slope to assist the carrying away of surface water should be selected for this crop, any approach to stagnant conditions being highly detrimental.

Warmth is essential, more particularly when the general conditions are not favourable. During the seeding year especially, Lucerne tends to burn during the late autumn and is at all times a sensitive plant when growth commences in the spring. Witte* recommends the selection of fields sloping towards the south, and they should be so situated as to be sheltered as far as possible from the prevailing winds. The necessity for shelter and at least a comparatively deep soil has been demonstrated by the trials at Aberystwyth. On exposed fields it was only possible to establish very poor stands and these burned badly in the autumn and again in the spring, not assuming a healthy green colour until the summer was far advanced. The importance of exercising care in the selection of a field needs to be emphasised, for this is a factor which may make the whole difference between success and failure, particularly to the man who desires to grow a small area only in a non-Lucerne district.

Preparation of the Soil.—Lucerne may follow almost any crop, while in parts of New Zealand excellent results have been obtained by sowing as a first crop on virgin land. A successful Essex practice is to sow in July (without a nurse crop) after a bare fallow.

The essence of soil preparation is to clean the land thoroughly, destroy all weed seedlings and provide a settled soil with a good surface tilth for the seed bed.

Manures and Inoculation.—Elofson† states that provided the situation is warm and sheltered, Lucerne can be grown successfully on soils naturally deficient in lime when adequate dressings of this substance have been applied. The first essential, therefore, on all non-calcareous soils is to attend to the liming of the field. The fact that an excellent stand of Lucerne (sown in spaced drills) has been obtained at Aberystwyth on a fairly sheltered corner which had been limed heavily the year previous to sowing, while only poor stands (sown

*See Witte, "Blåluzernodling"... *loc. cit.*
† *loc. cit.*

broadcast, in narrow and in spaced drills) have been obtained in the case of trials sown without lime, is probably not without significance in this connection.

There can be little doubt that on many soils a complete absence of a proper strain of nodule-forming bacterium constitutes an important limiting factor to successful Lucerne cultivation. Trials conducted by Wright in the West of Scotland (1905-1909),* using a culture provided by Dr. Hiltner, Munich,† gave the following results over a five-year period:—

Untreated Plot	100	= average per annum.
Nitrate of Soda Plot	123	= ,, ,, ,,
Inoculated Plot	130	= ,, ,, ,,

More recently, trials conducted by the Scottish Society for Research in Plant Breeding have also shown the benefits from inoculation in a very striking manner.‡

Trials conducted in America and in Sweden have also shown the benefits that may on occasion be derived by inoculation with artificial cultures, provided these are obtained from a reliable laboratory and used strictly in accordance with the instructions accompanying them.

A method of inoculation largely practised, and one which in many cases has given better results than artificial cultures, has been the spreading of soil taken from a field which has maintained a good Lucerne ley. The soil to be used should be obtained just before it is required and on a cloudy day; it must not be allowed to dry in transit; a quantity of about 500 lb. of soil per acre is recommended; and it should be harrowed in immediately after distribution.

Oakley and Westover state (1922) that in some recent experiments good results have been obtained by sowing equal quantities of soil and seed together. This method obviates the necessity of distributing large quantities of soil over a field, this being of course a somewhat costly operation.

In general farmers who propose to grow Lucerne for the first time in non-Lucerne districts are recommended to employ artificial cultures, but when a satisfactory first stand has been obtained re-inoculation from field to field by the soil method should thereafter become a regular practice.

* See Wright, R. Patrick: "Experiment on the Cultivation of Lucerne in Scotland: Effects of Inoculation," The West of Scotland Agr. College, Bull. No. 53, 1910.

† The Culture was mixed with dry sand and distributed over the surface of the soil.

‡ See Report 1923, p. 33-34.

It should not, however, be assumed that inoculation is always necessary, or that inoculation is alone sufficient to ensure a good crop of Lucerne. Thus, extensive trials conducted by the Ministry in 1920 and 1921 did not indicate marked benefits from inoculation, while Wright's trials previously referred to showed that nitrate of soda gave results but little less satisfactory than inoculation.

Trials conducted by Ward in New Zealand and by Arny and Thatcher at Minnesota, U.S.A., are of interest in this connection. The following comparative statement is based on data presented by these authors.

At Minnesota (U.S.A.)		*In Canterbury (N.Z.)*	
No treatment	100	No treatment	100
Soil from Lucerne Field alone...	109	Soil from Lucerne Field alone	182
Soil plus lime	113	Soil plus superphosphate ...	324
Lime alone	108	Superphosphate alone... ...	188

It will be noted that at Minnesota, inoculation alone and lime alone have had about equally good results, while in Canterbury the same has been true of inoculation alone and superphosphate alone, while at both centres the greatest benefits have been derived from the combination of the two treatments. It is thus evident that inoculation is not to be regarded as a self sufficient aid to productivity, but as an addition to the better known and more ordinary methods of liming and application of manures.*

Lucerne, like red clover, responds freely to farmyard manure, which is perhaps best applied to the crop immediately preceding a Lucerne ley. Thus in the case of manurial trials reported upon by the Harper Adams Agricultural College in 1912 the plot treated with farmyard manure (10 tons) had outyielded all combinations of artificials. An exhaustive series of trials conducted in Missouri, U.S.A., showed good results from farmyard manure in 86 per cent. of the cases where a satisfactory stand of Lucerne

* The following papers have been referred to or are of special interest in connection with inoculation :—

Oakley, R. A. and Westover, H. Q.: "How to grow Lucerne," U.S. Dept. Agr., Farmers' Bull. No. 1283.

Arny, A. C. and Thatcher, R. W.: "The Effect of Different Methods of Inoculation on the Yield and Protein Content of Alfalfa and Sweet Clover," Jour. Am. Soc. Agron., Vol. 7, 1915, p. 172.

Arny, A. C. and McGinnis, F. W.: "Methods of Applying Inoculated Soil to the Seeds of Leguminous Crops," *ibid* Vol. 13, 1921, p. 289.

Ward, F. E.: "Some Recent Lucerne Experiments in Canterbury," New Zealand Jour. Agr., Vol. 24, 1922, p. 226.

had been obtained.* At Saxmundham, farmyard manure has also given good results—but has not been responsible for such heavy yields as a combination of superphosphate and muriate of potash. On poor fields, nitrate of soda in small amount is recommended by Swedish investigators, as this helps the plants to establish themselves and assists them until the nodules have been developed; liquid manure applied before sowing is also recommended by Witte. At Saxmundham nitrate of soda has not justified itself on established leys. Dyer, however, conducting trials near Tonbridge (1897-1901) obtained excellent results by the addition of nitrate of soda to dressings containing phosphates and potash.† Nitrogenous manures should not be used on good land as they encourage the development of weeds, and especially of rough-stalked meadow grass and *Poa annua*.

The most essential manurial ingredient is usually phosphoric acid, which may be applied in the form of basic slag or of superphosphate, as may be convenient. Since Lucerne is usually removed from the field either as hay or green forage, potash should always be supplied. Fields left down for a number of years should receive from time to time top dressings of phosphoric and potassic manures. From trials conducted at two centres in East Suffolk it would appear that a dressing of 2 cwt. of superphosphate and 1 cwt. of muriate of potash may be regarded as an application which may be profitably employed,‡ this dressing having increased the average yield from 25 cwt. of hay (on the unmanured plot) to 68 cwt. per acre, over the period 1903-8. More recent trials in New South Wales have also shown the heaviest yields to be from top dressings of 1 cwt. of superphosphate and ½ cwt. of sulphate of potash, and it is concluded that about 1 cwt. of superphosphate per acre per annum is sufficient for the plant's needs after an initial dressing, and that potash generally enters into the fertiliser requirements of Lucerne.§

* University of Missouri. Agri. Expt. Station, Bulletin No. 106.

† Dyer, Bernard: "On Lucerne" Trans. High, and Agr. Soc. of Scotland, page 5, Vol. XIV, 1922.

‡ See Report of East Suffolk Education Committee for 1913.

§ Little, G. G., Lucerne Top Dressing Experiments (1913-16) Agri. Gazette of New South Wales, XXIV, 1923, p. 37.

CULTIVATION OF TURNIPS, SWEDES, AND KOHL RABI.*

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Yield Per Acre.—In most of the northern and western counties a yield of 20 to 25 tons per acre is only a normal result of ordinary good farming: in such a crop the individual "bulbs" weigh about 2 lb. The average yield over the whole of England during the ten years ended 1922, however, is officially recorded as 12.1 tons—about half a crop. In the eastern and the inland southern counties, natural conditions make the production of heavy turnip crops comparatively difficult, and once or twice in every decade there is a partial failure in many localities.

Difficulties in Turnip Cultivation.—In districts with high summer temperature, low rainfall and little dew formation during the growing season, turnip cultivation is risky on both light and heavy soils. The main risks are the following:—

1. Owing to dry conditions at sowing time, it is difficult to secure a plant: the seed may germinate very slowly and irregularly and the "fly" may destroy successive sowings, the result being that the growing period left is too short for the production of a full crop.

2. Dry weather in the latter part of summer, especially after leafy growth in the earlier portion, may bring on an attack of mildew.

3. On soured and infected land the crop may be attacked by finger-and-toe disease.

Where conditions are too hot and dry for successful turnip cultivation and mangolds do not meet the purposes intended, the suitability of kohl rabi should be considered.

In the moist cool conditions of coastal and northern counties and high-lying western districts, bad germination, "fly" and mildew troubles are not commonly met with. Moreover, the crop may be sown comparatively early, and it continues to grow far into the winter. The main difficulties under these conditions, besides finger-and-toe, are the following:—

1. Hand hoeing and singling may clash with hay-making operations.

* See "*Turnips, Swedes and Kohl Rabi for Stock Feeding*," by J. R. Bond. This *Journal*, February, 1924.

2. Continuous wet weather in early summer may enable the weeds to survive the hoe till the crop is too far advanced for further attempts at cleaning, the result being a dirty fallow and a poor root crop.

3. Wet weather in autumn may cause difficulties in harvesting the crop.

With a crop so much influenced by weather conditions as is the turnip, there can be no recipe for certain success. Nevertheless, as observation of results in practice shows, the risks of failure and disease can be considerably reduced by good management. Although in dairying and perhaps in cattle rearing the maximum practicable acreage should be devoted to root crops, it is better to cultivate a small area thoroughly than to attempt a larger acreage than can be effectively managed.

Autumn Tillage.—Turnips do best on a tilth that has been deeply worked and aerated a considerable time before sowing: but their predominant requirement is a sufficient and regular supply of moisture. Summer rains are proverbially beneficial to this crop; they are, however, insufficient to supply all the moisture necessary for a full yield. There is indeed a poor prospect and great risk of failure if at the time of sowing the soil is dry and there is no moisture reserve in the subsoil.

Autumn ploughing facilitates the admission of the winter rains into the subsoil, which should be capable of retaining a portion and during the following summer allowing it to pass upwards for the use of the crop. For autumn work the common plough may be preferred to the digger, as the broken furrow turned by the latter is apt to run together and hinder both percolation and aeration. In either case, the use of the large skim coulter is commendable when ploughing stubbles that have not been cleaned.

Autumn cleaning is desirable, as it conduces to a better conservation of moisture in spring; but the limitations imposed by soil and weather conditions, and the demands of other necessary work in autumn, usually cause the cleaning of the land for turnips to be deferred till spring. In some cases better advantage might be taken of the workable condition in which stubbles are usually found immediately after corn cutting and before they have become hardened by subsequent drying.

On heavy soils the land should be ridged up in autumn and the ridges split back once or twice during the winter.

Preferably the weeds should first have been eradicated, but in any case—even where the crop is to be sown on the flat—the superior tilth obtainable by winter ridging is a valuable factor in root cultivation on heavy soils.

Winter or Spring Manuring.—Experiments have failed to show the absolute superiority of either winter or spring application of the yard manure. Well-rotted manure applied in the ridges immediately before sowing gives excellent—perhaps the best—results in good turnip districts, provided that care is taken to avoid long exposure and drying of the ridges or manure before the latter is covered in. Where only a light dressing of yard manure is available, it is probably best applied in the ridges. Heavy dressings of long manure applied late in spring are apt to make soil-conditions too open for success, especially in dry districts.

It is obvious that application of the manure in advance saves time and reduces the pressure of work at a busy season; it also allows of cultivation on the flat, where moisture conditions favour this method; and it permits ridge drilling without the necessity of splitting the ridges at sowing time. When the land is dry enough in February, this is a good month to apply and cover the manure, as it will be sufficiently decayed to allow of cleaning operations at the proper time.

Spring Cultivations.—Where the turnip break receives no attention whatever between the ploughing in autumn or winter and the preparation of the seed bed in May, the likelihood of success is diminished. If the land has not been winter ridged, it should be cross ploughed when in a fit condition during February or early March, the effect being to deepen the layer of mellow aerated soil and to prevent excessive loss of moisture from the subsoil. Generally this work is best performed with the digger breast; but the main consideration is the state of the soil at the time the operation is proposed. Whether the land is or is not cross ploughed, however, it should not be allowed to lie through the drying weather of spring without a protective layer of loose soil on the surface: when dry enough not to smear, it should be chain- or plank-harrowed. Land so treated will subsequently work down to a tilth more readily and be less liable to form harsh clods than it is when left untouched till the commencement of cleaning operations.

In the work of cleaning and tilth formation, the field should be dealt with in successive strips, so that any lumps of soil

brought up may be broken by the following operation when they are in the right state of dryness to crumble—not allowed to dry through and form clods. On the stronger soils, the tilth is best secured by working from the top downwards in successive operations of increasing depth, rather than by first grubbing or ploughing-up the bottom soil and afterwards reducing the clods that form. The disc harrow is useful, but probably the greatest service is rendered by the spring-tooth harrow, which is also an excellent implement for bringing up the weeds. Very stiff soils that cannot be spring-cleaned otherwise than by "roasting in the clod" are difficult to prepare successfully for turnips, unless they have been autumn cleaned and winter ridged.

Ridge or Flat?—There is little experimental evidence on this point. Ridge cultivation is the rule in the districts that have the best yield records; and there is no doubt that roots may be earlier and better cleaned when sown on ridges. Also the harvesting of the crop may be effected with less injury to the land when the rows have been lightly moulded up after the last horse hoeing. When ridges have to be made, however, the rows must be spaced wider than is necessary in flat work; and more thorough preparation and deeper tillage is required to allow of ridging than is needed for sowing on the flat. It is generally accepted that the flat system is preferable under conditions of low summer rainfall. Observation in the dry season of 1921 did not, however, confirm the expectation that better brairds would be secured on the flat than on ridges, probably because the rolling given after drilling achieved better consolidation in the ridges.

A good compromise between the two methods may be obtained as follows: ridges are drawn up and allowed to settle and become moist in the middle. Just before sowing, a chain harrow is run along them to destroy annual weeds and to expose the moist soil, in which the turnip seed will immediately germinate. This method is of great assistance in dealing with a cloddy seed bed. The ridge plough (more so than the single-breast implement) is apt to gather the clods on to the top of the ridge, where they cover the fine earth required by the seed. If the seed be drilled among clods and a plant be obtained, the work of striking and singling is exceedingly difficult, the seedlings having long thin stems growing round the clods. Chain harrowing before drilling rolls the clods off the ridges.

Width of Rows.—The heaviest crops can be obtained by drilling in close rows. Crops drilled on ridges only 20 in. apart may be found in competitions. It is questionable, however, whether the additional labour and inconvenience involved in working such narrow rows is warranted by the increase in yield obtained. With special blades it is possible to hoe, without covering or injuring the seedlings, in rows narrower than those required where only the ordinary implement is used; but on heavy land, and generally where the land is not very clean at the time of sowing, the standard width of 27 in. should be adopted.

Time of Sowing.—The only safe guide in this matter is local experience. In good turnip districts swedes may be sown early in May, whereas in dry sunny localities crops sown at this time would be liable to contract mildew later in the season. Early sowing is advisable where conditions will permit its adoption, as the risk of "fly" is reduced and a heavier crop can be obtained. Too early sowing, however, involves the risk of the crop bolting, as it did in 1923. Purple tops sown very early are also liable to keep badly in winter. Early and mid-June are common times for sowing swedes in the midland and southern counties. Yellow turnips, being of quicker growth, are usually sown when the season is three or four weeks too far advanced for the expectation of good results with swedes. Soft turnips are of still quicker growth. Kohl rabi needs a longer growing season than swedes, being comparable with mangolds in the time of sowing. With root crops in general it is better to defer sowing with a view to cleaning the land properly than to sow by a certain date and have to depend on additional hoeing to keep down weeds.

Seed.—Turnip seed is not sold in grades, otherwise the farmer would be advised to purchase samples with the largest seeds, as these give the strongest plants and the heaviest crops. Steeping the seed in turpentine with a view to the prevention of "fly" does not impair the germination. In the Royal Agricultural College experiments, steeping for 6 days was found to have rather a favourable effect on the vitality of the seed.

Kinds and Varieties.—The special properties of kohl rabi are that it will germinate and grow on a tilth that is too harsh for swedes; it continues to grow during dry periods when turnips stagnate or take mildew; and it is comparatively immune to finger-and-toe. It is not readily injured by autumn frosts

and its feeding properties are equal to those of swedes. Rabbits and pigeons are, however, very fond of it; and, unless it can be sown very early, it will yield considerably less in good turnip districts than a crop of swedes. Bearing transplanting well, it may be sown in March in a small seed bed, and afterwards set out in the field.

As regards the respective merits of swedes and yellow turnips, the former generally yield as many tons per acre and roots of higher feeding value and better keeping quality than yellows. The latter can grow on soil too dry for swedes and they can be sown later. Yellows and white turnips are probably most necessary in sheep farming, for use in autumn before swedes are sufficiently ripe for safe folding. Swedes, but not other kinds of turnip, may be transplanted—as is common practice in Germany, where the "fly" is so troublesome in field sowing.

The results of the innumerable field trials comparing varieties of swedes and of other kinds of turnip have not been of wide service. Methods of turnip cultivation vary, and climatic conditions are not the same in different districts. Each farmer should carry out his own trials, utilising as a basis his own experience and that gained by the local agricultural college or organiser in trials. As regards the two main groups of swede varieties—the purple tops and the greenish tops, the latter appear to be the harder-fleshed sorts and of better keeping quality, but requiring good conditions and early sowing. They are not, however, of any higher feeding value, and they may not be so suitable as purple tops for early use or for districts where late sowing is necessary. Eclipse, Goliath and Tipperary are good purple tops; Longkeeper, Empire and Caledonian are good bronze tops. Invincible is an outstandingly good yellow turnip.

After-Cultivations.—The seed-drill is usually equipped with rollers that consolidate the soil sufficiently for turnips, which do not demand such a solid seed-bed as mangolds. When between sowing and germination the top of the ridge or row becomes loose and open, the land roller should be applied. Rolling is also beneficial when, owing to looseness and dryness of soil, the seedlings remain too long in the "two-leaf" stage: the fear of injury to the plants by rolling at this stage is without good foundation.

The work of hand hoeing—a serious drawback to turnip cultivation—can be greatly forwarded by the assistance of

proper mechanical equipment. Some drills may be fitted with a pair of trailing blades which pare away the weeds on each side of the line of plants. This device works best on low ridges. Special blades may fitted to horse hoes to allow of shallow hoeing close to the plants. Where considerable areas of roots are grown, the three-row steerage horse hoe should be adopted, extra care being taken to ensure that the drill rows are spaced at uniform and regular distances.

Deep horse-hoeing between turnip rows undoubtedly injures the crop, especially when it is half grown. Before the tops meet across the row spaces, the soil will be found to be full of root fibres, these being too near the surface to allow of more than superficial movement of the soil. The necessity for much and late hoeing can be avoided only by proper cleaning before the crop is drilled. Early hoeing to keep the soil surface in mulch form not only destroys weeds but helps to conserve moisture and promotes nitrification. When the tops begin to shade the soil, the liability of the land to become crusted ceases. Earthing-up the crop in July is a common practice in Lancashire and certain other counties. Perhaps its main advantage is that it prevents so much poaching of the land at lifting and carting. Whether it materially promotes the growth of the plants has not been tested experimentally, but undoubtedly the operation checks weeds. In this work the main precautions are to avoid leaving it too late, and not to throw up a high coating of soil that will cause the bulbs to send out fibres at such a level as will make it difficult to clean them.

Singling experiments have proved nothing, except that the crop yields about the same weight of roots per acre whether there are several small turnips per foot of drill or only a single large one. It is doubtful whether there is real advantage in leaving the plants closer than 10 in. apart in 24 in. drills. Of greater importance than uniform spacing to a certain distance, is the date at which the singling is effected: delay in the first cleaning and thinning may do great harm. The weeds and surplus plants not only crowd the crop above ground but they take up moisture and available plant food, removing it from the crop plants when the late cleaning is effected. It would appear, from what may often be seen in practice, that greater encouragement should be given to the improvement of mechanical devices to reduce the hand labour of striking and singling.*

*See *Turnip Thinning and Harvesting* (Trials of Machines). This *Journal*, February, 1923, p. 973.

Storage.—In the conservation of swedes in covered heaps, the main point to bear in mind is the fact that the bulb dies and decays if suffocated by lack of air. A narrow heap covered with waste hay held down with a thin layer of soil provides the requisite conditions for good keeping.

Finger-and-Toe.—The presence of the specific organism causing the disease is necessary before a crop can be attacked by finger-and-toe; but the degree of the pest's destructiveness is determined by conditions, of which two are known, viz.:—the presence or absence of acidity in the soil, and the susceptibility of the plant cultivated.

Finger-and-toe is encouraged by the temporary sourness caused by lack of aeration, such as occurs in wet places, or in heavy land ploughed too late or in wet condition, or on headlands that are unavoidably much trampled and afterwards forced into a tilth. It is well known that turnips following potatoes are little affected with this disease, owing probably to the thorough aeration the soil receives during the cultivation of the potato crop; and winter ridging and splitting reduce the ravages of the pest on heavy land. Light land, however, that may be thought not to lack aeration is often badly affected. In this case, and usually if not always in that of heavy soils, the fundamental cause of the trouble is deficiency of lime. The fact that liming checks finger-and-toe has been known for at least 90 years, but the knowledge is not so generally applied as its antiquity might suggest. Gas lime has been found to be of little value in this connection, but carbonate of lime has given results equal to those afforded by quicklime.

The quantity of lime necessary to neutralise soil acidity varies: in some cases a dressing of 2 tons per acre is insufficient and has little effect on the disease. In this matter the assistance of the Advisory Chemist for the district is valuable* At Cockle Park, in experiments on heavy soil, the lime dressings were most effective in the fourth and later years after their application. At Craibstone (Aberdeen) on light land, however, the benefit began to show in the second turnip crop. In this case, where successive yearly applications of lime were made until the soil showed no lime requirement, it was found that the amount of lime necessarily so added was nearly 6 tons of ground lime per acre on one plot and nearly 8 tons of carbonate of lime on the other. The results in 1922 (the plots having been under turnips every year since 1915) were as shown in the

*See Leaflet 279. *Technical Advice for Farmers.*

following summary compiled from tables in Professor Hendrick's report (*Trans. Highland and Agric. Soc.*, 1923):—

Treatment.	*Yield per acre.*	*No. of plants surviving per acre.*	*No. of bulbs sound or slightly diseased.*	*No. of bulbs rotten or badly diseased.*
	Tons Cwt.		per cent.	per cent.
No lime	4 13	15,540	11·6	88·4
Ground lime ...	13 1	29,840	45·3	54·7
Carbonate of lime	13 2	31,140	60·9	39·1

No variety at present on the market has been proved to be immune to finger-and-toe; but the simple experiment of sowing several sorts on infected land will reveal considerable differences in their susceptibility. The Danish State Experimental Station at Herning has for some years been engaged in selecting Bangholm swedes cultivated on infected land with a view to the production of a highly resistant strain. In trials in North Wales and Derbyshire, this strain has been found to possess a higher degree of resistance than ordinary kinds. In Derbyshire, Tipperary and Longkeeper swedes, Purple-top disease-resister yellow turnip, and kohl rabi, have been found to be less susceptible to finger-and-toe than a number of other varieites included in the tests.*

Continuous Turnip Culture.—The effect of lengthening the rotation with a view to avoiding finger-and-toe disease is often nullified by the presence of charlock and other cruciferous weeds (which perpetuate the disease), and by the necessary application of yard manure to the land, the yard manure being infected by the consumption of diseased roots. For the prevention of the disease, rotation changes are less effective than the removal of the aggravating conditions.

The dairy farmer is often deterred from cultivating a useful proportion of arable land because of the fear of this disease. The root crop is what he specially desires; but he is not disposed to cultivate four or five times the acreage of less necessary crops in order to maintain a proper rotation. In districts favourable to mangolds, dairy farmers often grow this crop for years in succession on the same—their only—piece of arable land. It has been shown that, provided attention is given to the lime requirement of the soil, the same method is possible with turnips. Hendrick quotes a case where the same field has been under continuous turnip culture for nearly 30 years, and in 1922 the grower reported "excel-

* See *Varieties of Swedes Resistant to Finger-and-Toe.* This *Journal*, July, 1922, p. 362.

lent results . . . . . 30 tons per acre and free from disease." The reason for the practice on this farm is that only this field of 13 acres is suitable for turnips, the rest of the farm being very heavy land. Every year ground lime is applied at the rate of 10 cwt. per acre; an ordinary dressing of dung, about 12 tons per acre, is applied once in six years, but every year a good dressing of about 10 cwt. per acre of artificial manures is given. The soil was tested by Hendrick in 1918 and showed no "lime requirement" and no trace of sourness.

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AGRICULTURAL RESEARCH EXHIBITS AT THE BRITISH EMPIRE EXHIBITION.

THE main object of the agricultural research exhibits at the British Empire Exhibition is to depict by examples the application of research to various branches of agriculture. The exhibit will be divided into eight main groups so arranged as to tell a continuous story:—

Animal Breeding and Nutrition (including Dairying), Veterinary Science, Soils, Plant Breeding, Horticulture, Plant Pathology, Agricultural Machinery, Agricultural Economics.

Group I. Animal Breeding and Nutrition (including Dairying).—Fundamental principles on which the scientific breeding of all animals may be based are being established by breeding experiments with poultry and other small livestock at the Animal Breeding Research Institute, University of Edinburgh and at the Department of Genetics, University of Cambridge. The application of this will be shown by the Edinburgh Institute in an exhibit on "Sex Studies in Fowls" and by the latter on "Sex-linked inheritance in Poultry."

It is generally recognised that there is need for much improvement in the wool of British breeds of sheep to-day. Research work in this connection will be illustrated by an exhibit on "Wool improvement by hybridisation," from the Edinburgh Institute. Another side of the work conducted at that Institute —Sex determination and differentiation in domestic mammals— will be shown by an exhibit illustrating "Intersexuality of the Goat." In the same group the School of Agriculture, Cambridge, will illustrate its work on "Fertility and sterility in Domestic Animals (the cow, sow and rabbit)."

Following upon these breeding questions the Rowett Research Institute, Aberdeen, will deal with one of the main lines of feeding investigations—the mineral requirements of animals. Further, in the exhibit of the National Institute for Research in Dairying the idea of "Milk as a source of energy from the Sun" will be introduced to depict research on winter *versus* summer feeding of dairy cows. Within the province of the National Institute for Research in Dairying are included all questions relating to the production, handling and distribution of milk, and the manufacture of dairy produce. Several of these branches of work will be illustrated.

Group II. Veterinary Science.—Following the breeding and feeding of animals the next group will be devoted to some of the research work on the diseases to which these animals are liable and the methods of control. The Animal Diseases Research Association of Glasgow and the Ministry's Veterinary Laboratory will deal with such bacterial diseases as braxy, swine erysipelas, tuberculosis, glanders and dysentery, ultra-visible virus diseases, such as foot-and-mouth, swine fever and roup. The worm parasites of domesticated animals and the pathology and epizootiology of the diseases caused by them, such as fluke disease in sheep, gapes in poultry and pimply gut, will be illustrated in the Institute of Agricultural Helminthology exhibit.

Group III. Soils.—As a necessary introduction to the plant breeding and horticultural groups, Group III (arranged by the Rothamsted Experimental Station), will deal with the properties of the soil and the question of getting the land into good "heart" or "tilth," which, as every farmer and gardener knows, is essential if plants are to maintain a healthy growth and satisfactory yields are to be obtained.

Group IV. Plant Breeding.—Perhaps in no other branch of agricultural science can the immediate value of research be shown so well as in the case of investigations into plant breeding, for it requires no power of argument to demonstrate the gain, not only to the farmer or horticulturist, but to the nation, derived from the introduction of a new or improved plant. The Welsh Plant Breeding Station, which is primarily concerned with the improvement of herbage plants, will contribute specimens of perennial rye grass and tall oat grass to illustrate variations found within a species—the necessary preliminary work to the improvement of the species. Cereals will be dealt

with by the Scottish Plant Breeding Station (Improvement of Oats by selection and hybridisation) and the Cambridge Plant Breeding Station (the methods used in the breeding of improved forms of wheat and also some of the new forms which are being "grown on" for distribution). The National Institute of Agricultural Botany will provide a Potato exhibit, alternating with exhibits on "Yield testing of cereals" and "Seed Testing" as conducted at the Official Seed Testing Station for England and Wales.

Group V. Horticulture.—This group deals with the "breeding" and improvement of fruit trees and the control of the diseases to which they and other horticultural crops are liable. "Pollination," a vital factor in obtaining good crops, is to be dealt with in the Royal Horticultural Society's exhibit, while another subject of great importance to commercial and amateur fruit growers, "The Control of the Fruit Tree through its roots" will be illustrated by "paradise" stocks (the root stocks raised from cuttings or layers) from East Malling Research Station, and by "free" and "crab" classes (raised from seed) from Long Ashton Research Station. The latter will also deal with the manuring of fruit trees, fruit bud formation and big bud and reversion of black currants. Adjoining will be a case containing preserved specimens of typical fruits in their natural characteristic colours, grown in England in 1923. The Ministry's Horticultural Division is arranging this exhibit and also one of a model allotment to show, on a scale of 1/12th natural size, the arrangement and cropping of an ordinary 10 rod allotment laid out as recommended by the Ministry. Some of the pests and diseases which attack horticultural crops are dealt with in the exhibit from the Cheshunt Experimental Research Station, which specialises in glasshouse-crop pests and diseases and their control.

Group VI. Plant Pathology.—The importance of extended and continuous research into the numerous pests—insect and fungus—which annually take such heavy toll of the farmer's and gardener's crops needs no emphasis. The exhibit from the Institute for Research into Plant Diseases, Rothamsted, will illustrate investigations being carried out there to combat these pests. The Ministry's Pathological Laboratory at Harpenden is arranging an exhibit in this group in conjunction with various advisory centres throughout the country. In addition, the Institute of Agricultural Helminthology is illustrating the effect

of parasitic worms upon the growth of clover, wheat, and strawberries.

Group VII. Agricultural Machinery.—In the centre of the Ministry's gallery there will be a model illustrating an up-to-date power farm with various field operations in progress. Fuller details of this exhibit will appear in a later issue of the *Journal*.

Group VIII. Agricultural Economics.—No exhibit illustrative of agricultural research would be complete without reference to the book-keeping side of farming, consequently the School of Rural Economy, Oxford, has promised to illustrate, on broad lines, the costs of production and yields of various farm produce.

Fuller details of all these exhibits will be published in a Guide which will be on sale in the Ministry's Gallery in the British Government Pavilion, and, to supplement the Guide, qualified guide-lecturers will attend to explain the significance of the specimens and pictures at stated intervals daily from the 23rd April next, when it is hoped that H.M. the King will officially open the British Empire Exhibition, until October.

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THE COST OF GRAZING.

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THE English farmer is often and possibly rightly blamed for the fact that his farm books are made to reveal very little information, which may be of practical and economic value. Whilst the truth of this cannot altogether be denied, it must also be borne in mind that in the determination of farm costs things are not quite so simple as they might at first sight appear. The determination of the cost of grazing on any particular farm possibly illustrates these difficulties better than anything else.

If we wish to determine the cost of grazing permanent pasture things may be easy, but when the aftermath either of seeds or meadow hay is grazed, an estimate has to be made, and the correctness or otherwise of this estimate will seriously affect the figure finally arrived at. Again, if we charge up to grazing the rent, rates, manure bill, man and horse labour employed on the grassland, these can be settled more or less accurately, so that the determination of the acreage cost of grazing should really create very few difficulties. This determination, however, by itself is of very little value; what is wanted is the cost of

grazing per unit of stock, and as the grassland may be grazed either by dairy cattle, feeding beasts, young stock, horses, sheep, pigs, or even poultry, the proper allocation of this cost amongst the various heads of stock will again necessitate our making another estimate, which will enable us to express the stock-carrying capacity of the land in terms of either sheep or cow equivalents. Evidently, therefore, if we wish to compare the relative costs of grazing on different farms, for the sake of comparison the various results must be placed on a comparable basis. For the sake of uniformity it is usually agreed that one-third of the full rent, rates and manure bill of the meadow shall be charged to the cost of grazing the fog; and that in apportioning the costs of pasturage amongst the various classes of stock we may regard—

1 calf as being equivalent to	2	sheep.
1 heifer or store beast as equivalent to ...	4·5	„
1 cow or fattening bullock as equivalent to ...	6	„
1 horse as equivalent to	6	„

Determination of Cost.—Making use of the methods outlined above, the following results were obtained during the year 1919, when the grazing of 976 acres on twelve different farms in Yorkshire was closely investigated. This grassland carried during the year:—403 cows, 100 feeding bullocks and heifers, 91 young stock, 40 working horses, 16 young horses, 426 sheep, 45 pigs and 130 head of poultry. This was the equivalent of 4,083 sheep or 680 cows, and the land therefore carried the equivalent of 1 cow to 1.43 acres.

TABLE I.

GRAZING ACCOUNT, 1919.

12 *Farms.* 976 *Acres.*

	£	s.	d.	*Stock Carried.*	*Sheep equiv.*	£	s.	d.
Rent ...	1,225	11	8	403 Cows	2,418	1,987	19	3
Rates... ...	328	17	3	100 Bullocks and Heifers	500	410	8	4
Seed	36	9	7	91 Young Stock	364	298	15	8
Manure ...	8	0	16	3 40 Working Horses	240	197	0	0
Incidentals ...	370	1	8	16 Young Horses	80	65	13	4
Labour—				426 Sheep	426	349	13	6
(*a*) Man ...	334	9	4	45 Pigs	45	36	18	9
(*b*) Horse ...	148	7	3	130 Head of Poultry	10	8	4	2
	£3,354	13	0		4,083	£3,354	13	0

From such an account as that given in Table I it is easily possible to determine the cost per acre, per cow equivalent, or per sheep equivalent, and to compare the relative importance of each of the varying factors which go to make up that cost.

TABLE II.

SUMMARY OF COSTS OF GRAZING.

	Total cost.	Cost per acre.	Cost per sheep.	Cost per cow, &c.	Per cent. cost.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Rent	1,225 11 8	1 5 1	0 6 0	1 16 0	36·7
Rates	328 17 3	0 6 9	0 1 7	0 9 6	9·6
Seed	36 9 7	0 0 9	0 0 2	0 1 0	1·1
Manure ...	890 16 3	0 18 3	0 4 4½	1 6 4	26·7
Incidentals ...	37 1 8	0 7 7	0 1 10	0 1½ 0	1·2
Labour—(*a*) Man	334 9 4	0 6 10	0 1 7¾	0 9 7	9·6
(*b*) Horse	168 7 3	0 3 5	0 0 10	0 5 0	5·1
TOTAL ...	£3,354 13 0	£3 8 8	£0 16 5	£1 18 5	100·0

From Table II it will be seen that the cost of grazing amounted to (*a*) £3 8s. 8d. per acre; (*b*) 16s. 5d. per sheep per year; (*c*) £4 18s. 5d. per cow per year; and that the grassland in that year on those farms carried an equivalent of 1 cow to 1.43 acres. If we assume that the cows were out at grass for twenty-two weeks during the year, it would give us a figure of 4s. 6d. as the average cost of grazing per cow per week, a useful figure for the man who was joisting milch cows at that time. We may take five-sixths of this figure, or £4 2s. 1d. as the cost of grazing a heifer, which would give us 1s. 7d. per week during the whole year. Assuming the winter grazing to be, roughly speaking, one-fifth of the value of the summer grazing, we may charge £3 5s. 1d. for the summer grazing per heifer, and 17s. 0d. for the winter grazing per heifer, which would work out at 2s. 6d. per head per week during the summer, and 3d. per head per week in the winter.

Again, this cost of grazing amounted to 16s. 5d. per sheep equivalent per year, which would correspond to 3¾d. per sheep per week all the year round, or approximately 5½d. per sheep per week during the summer months, and from 1½d. to 2d. during the time they were running out in winter.

Manuring.—A more detailed examination of the manure bill for the pasture in 1919, showed that during that year 90 tons slag, 52 tons lime, 14 tons superphosphate, 4 tons sulphate of ammonia, and 239 loads of farmyard manure had been applied. If this can be taken as typical of other years it would allow for a dressing of the grazing land of—

3 loads of dung per acre every twelfth year.
7 cwt. „ slag „ „ „ fourth „
8 „ „ lime „ „ „ eighth „
1½ „ „ superphosphate „ fourth „
½ „ „ sulphate of ammonia every sixth year.

This would suggest that the average Yorkshire farmer is beginning to realise the importance of the improvement of his grassland. The importance of such improvement can be realised when it is remembered that to-day the grassland farmer is in a much sounder financial position than his arable brother, and that, with very few exceptions, where money is being made to-day on the farm, it is being made on produce which walks to the market.

Labour.—From the details given in Table II it will be seen that the total labour bill amounted to 6s. 10d. per acre for man labour and 3s. 5d. per acre for horse labour, and that these constituted 9.6 and 5.1 per cent. respectively of the total costs. Evidently in grazing, labour is one of the minor expenses, and as will be pointed out later on, the increased wages paid on the farm since the appointment of the Wages Board in 1917 have, in consequence, had less effect in adding to the cost of grazing, than to that of any other farm crop.

TABLE III.

LABOUR COSTS PER ACRE OF PASTURE.

	Man.		Horse.		Total.
	No. of days.	Cost.	No. of days.	Cost.	
		s. d.		s. d.	s. d.
Draining and Ditching	0·13	1 1	0·04	0 2	1 3
Trimming Hedges and Repairing Fences	0·33	2 7	0·10	0 6½	3 1½
Applying Artificials	0·05	0 5	0·05	0 5	0 10
„ F.Y. Manure .. .	0·04	0 4	0·04	0 2½	0 6½
„ Liquid Manure	0·05	0 ½	0·05	0 3½	0 8
Cutting Thistles	0·11	0 10½	0·05	0 3½	1 2
Chain Harrowing	0·08	0 6½	0·14	0 9½	1 4
Rolling	0·07	0 7½	0·10	0 8½	1 4
Total	0·86	6 10	0·57	3 5	10 3

In Table III are summarised the details of the labour employed on the pasture during the year referred to, from which it will be seen that it amounted annually to approximately 1 full day's work per acre for a man, and one-half a full day's work for a horse, at a total cost of 10s. 3d. per acre. The upkeep of the fences, draining, and cutting of thistles accounted for 54 per cent. of the total cost, whilst chain harrowing and rolling accounted for 26 per cent., the remaining labour being taken up almost entirely with the application of artificials, farmyard

TABLE IV.

YEARLY VARIATIONS IN THE COST OF GRAZING PER ACRE.

No. of Farms...	5	5	6	7	8	12	20	25	34
Year	1914	1915	1916	1917	1918	1919	1920	1921	1922
Rent	£1 4 0	£1 4 2	£1 4 6	£1 4 8	£1 5 2	£1 5 1	£1 4 1	£1 5 2	£1 8 5
Rates	0 3 6	0 3 11	0 4 2	0 4 9	0 5 6	0 6 9	0 7 1	0 6 10	0 8 1
Seed	...	...	...	...	...	0 0 9	0 0 11	0 1 7	0 0 1
Manure	0 4 3	0 3 9	0 8 8	0 7 7	0 13 10	0 18 3	0 10 1	0 6 11	0 3 9
Incidentals	0 1 2	0 1 6	0 3 9	0 5 6	0 6 8	0 7 7	0 8 0	0 9 4	0 10 8
Labour (*a*) Man	0 3 2	0 3 8	0 4 2	0 5 2	0 6 3	0 6 10	0 7 11	0 9 0	0 5 5
,, (*b*) Horse .:. ...	0 1 8	0 2 6	0 2 10	0 3 0	0 3 3	0 3 5	0 3 4	0 3 5	0 2 11
Total Cost	1 18 0	1 19 5	2 8 1	2 10 8	3 0 8	3 8 8	3 1 5	3 2 3	2 19 4
No. of cow equivalent carried per acre	1·38	1·52	1·47	1·49	1·52	1·43	1·53	1·46	1·46
Cost per cow equivalent ...	£2 13 0	£3 0 6	£3 10 8	£3 15 4	£4 12 6	£4 18 5	£5 0 1	£4 12 6	£4 6 0
Cost per cow per week when at grass	0 2 5	0 2 9	0 3 2	0 3 5	0 4 2	0 4 6	0 4 7	0 4 2	0 3 11

manure and liquid manure. This average figure of approximately one day's man labour per acre has been confirmed by the average records of each successive year.

Yearly Variations.—It will be seen from the details given in Table IV that the cost of grazing, which in 1914 was approximately 2s. 5d. per cow per week, reached its maximum in the summer of 1920, when it amounted to 4s. 7d. and has since fallen gradually, though in 1922 it still stood at 3s. 11d. per head per week, approximately 62 per cent. above pre-war level.

The number of farms is not uniform, and these figures are not therefore altogether comparable, but it will be seen that while the average rent of the land has remained practically stationary, the rates have steadily mounted up, until in 1922 they amounted to nearly two and a half times their pre-war figure. There is no doubt that when allowance is made for the recent reduction in the rates on agricultural land, they will be found to have reached their maximum in the year 1922-23.

The manure bill per acre is seen to have reached its maximum in the year 1919, and to have steadily fallen since. The abnormally high figure in 1919 is in all probability due to two things: (1) to the fact that the prices of the artificials usually applied to grassland were at that time at their highest, and (2) to the fact that the twelve farms included in the year 1919, were all doing their grassland well, possibly better than usual.

Incidental Expenses.—The increase in the Incidental Expenses, corresponding to what may be called the non-productive charges such as tradesmen's bills, upkeep of fences and repairs to implements, which are at their minimum on grassland, and reach their maximum on arable crops like potatoes, is significant of the burden which the farmer at the present time is having to carry. There is no doubt that a crying need of agriculture to-day, is a reduction in the cost of production, whether of grazing or of any other farm crops, and possibly nowhere is it more needed that in the cost of various tradesmen's bills which the farmer has to meet. The following comparative costs of a few of these items extracted from the books of one particular farm are certainly significant:—

	1916.	1922.
	£	£
Wage Bill	2,217	5,626
Coal ,, ...	84	252
Fuel ,, ...	53	146
Blacksmith's and Implement Repairs	48	248
Shoeing Bill	20	78
Saddler's ,, ...	26	68

The whole farm has to bear the burden of these charges, and although the grassland bears only a relatively small proportion of these, yet, in 1922, they corresponded to a charge of 8d. per week for the grazing of each individual cow.

Labour.—It has already been pointed out that each acre of grassland absorbs approximately one full day's work for a man, and rather more than one-half of a day's work for a horse per year. This means that to all intents and purposes, the yearly variations in the cost of the man labour per acre of grazing, approximately correspond to the yearly variations in the daily wage of the men employed on the farm, which reached its maximum in the year 1921.

Again, the yearly variation in the cost of horse labour per acre of grazing will approximately correspond to half the cost of horse labour per working day.

Comparative Costs on Varying Farms.—For the year 1922-23 the average acreage cost of grazing amounted to £2 19s. 4d., and the average cost per cow equivalent to £4 6s. 0d. per year (or 3s. 11d. per head per week whilst the cows were at grass), but very varying results have been obtained on the different farms on which the cost of grazing has been investigated. The acreage costs varied between the extreme limits of £1 14s. 7d. and £8 4s. 4d. The extreme variations in the stocking can be seen from the fact that on the most heavily stocked farm each cow equivalent had the grazing of 0.7 acres, and on the least heavily stocked farm each cow had the grazing of 3.4 acres, while the actual cost of grazing per cow equivalent varied from £2 2s. 6d. per cow per year (approximately 2s. per cow per week when at grass), to £9 10s. 6d. per cow per year (approximately 8s. 6d. per cow per week when at grass).

In an article of this description it is obviously impossible to give the varying cost on each individual farm, yet it may be interesting to show some of the variations, and if possible to trace down the factors responsible for them. Evidently what is to be aimed at, if the most is to be made of the land, is to increase its stock-carrying capacity as far as possible at the minimum cost, and the most successful grassland farmer will be he who is grazing land with a high stock-carrying capacity at a low acreage cost.

It does not necessarily follow from this that the cheapest and lowest rented land is always the best, but the rent should be theoretically proportional to the inherent fertility of the soil, other factors such as nearness to markets, etc., being taken into account.

(1) *High Costs of Grazing.*—A high acreage cost may be due to one or more things. (*a*) The *rent*, and consequently the *rates*, may be heavier than the farm can reasonably be expected to carry. At the present time this is undoubtedly the case with a very large number of smallholdings, though as far as we have seen these rents rarely if ever give an adequate economic return for the money invested in enclosing, fencing and draining the land, and putting up the necessary house and buildings.

H.W.C. is a smallholding of 16 acres of grassland on the outskirts of one of the industrial towns in Yorkshire. The rent charged corresponds to less than 2 per cent. of the landlord's capital actually invested in the holding. It is good grass, well managed, heavily stocked, and treated on thoroughly orthodox lines, but killed by high rents and high rates, amounting to no less than £5 12s. per acre, and constituting 68 per cent. of the total cost. Had this holding been double the size, the capital outlay for buildings and housing accommodation for the stock would have been very much smaller in proportion.

(*b*) The land may be heavily burdened by being made to carry too high a proportion of the *non-productive charges* to which reference has been made.

The grassland on farm C.W.L. is heavily stocked and has been got into good condition. The rent and rates are both normal, but from an economic point of view the farm is being killed by its high standing charges. A casual observer going round the farm would be struck by its general neatness and good condition, the fences, roads, gates and doors appealing to the eye—though they have left their records in the balance sheet!

(2) *Understocking.*—The actual cost of grazing per head of stock will be determined by the acreage cost of grazing and the number of stock per acre which the grassland carries. Particularly in recent years, a large number of cases have been met with where the cost per head of stock has been too high owing to the fact that the grassland has not been carrying the stock it could and should be made to carry.

(*a*) It may have been deliberately understocked, either on account of shortage of capital, or because the holder hesitated on a falling market to invest heavily in store stock.

(*b*) The understocking may have been due to the fact that the grassland needed improvement either by way of draining, liming or manurial treatment.

The grassland on farms H.N.O. and H.C.B. is at the present time in quite good condition: both have kept their acreage costs as low as possible compatible with efficiency, but both last year deliberately reduced the head of stock that they normally carry. H.N.O. usually runs from 25 to 30 cows, and in addition fattens some 50 to 60 Irish bullocks or heifers on grass. In 1921-22 he was heavily caught with the falling market, and in 1922-23 cut down his purchases of Irish store cattle and failed to make any use whatever of his surplus grass. H.C.B. used to run about the same number of milk cows, but being in

a district in the North Riding where milk prices have been utterly inadequate, he has reduced his stock of cows, but has not wasted his surplus grass. Much of the grass, which has been improved immensely, was meadowed. On some, sheep together with Irish cattle were joisted, and hay grown on the meadow which had previously been grazed was sold to the owners of the joisted stock to be consumed on the land; whilst an additional sixty-seven tons of hay were available for sale for consumption off the farm. This man covered himself economically by reducing the number of his own stock, but made the best possible use of his surplus grass, with the result that the acreage costs of grazing, and his cost per unit of stock grazed were both low.

(3) *Improvements.*—There is no doubt that a great deal of the grassland throughout the country, and particularly in the West Riding of Yorkshire, is not carrying the stock it could were it properly treated. This is especially the case on the coal measure and millstone grit soils naturally deficient in lime, which through their proximity to the industrial towns have been still further depleted in this respect by means of the acid nature of the rain. In other districts lack of drainage is the determining feature. In some of the latter cases this factor is under the control of the man who is farming the land, in others unfortunately it may be beyond his control.

In the case of farm C.N.D., for example, this latter holds good; his land, forty miles from the sea as the crow flies, is sixteen feet above sea level. It is well drained as far as he is concerned, and the dykes and drains are kept scrupulously clean, but the outlet of his drains has frequently been seen to be below the level of the water in the Commissioners' drains. This man has drained his land, limed it and slagged it, and improved it up to the hilt, as far as he is concerned, but the determining factor in the fertility of his land and its stock-carrying capacity is the regularity or otherwise of the Commissioners' pumping station a mile lower down.

On D.F.O.'s land, the determining factor again has been drainage, but a factor this time under his control. This land is a very heavy clay, which had been drained years ago, but when this man took over the farm in 1917 it was in practically a derelict condition. Most of the drains were blocked, none of the dykes cleaned out and the land thoroughly waterlogged. During the first year he tackled the dykes; most of the drains are now running; surface cuts or gripes have been made; the worst of the land has been limed, and much of it slagged and sheep run on the higher parts of the farm. The stock-carrying capacity has increased by more than fifty per cent., but it will be another two years at least before the land is got back into its proper condition, and able to carry all the stock that it should.

The case of J.H.S. is again interesting. The farm is on low-rented poor land at the edge of the coal measure soils, and little or no attempt has up to now been made to improve it. With its low rent and low rates, no outlay on farmyard manure, artificials and lime, and small expenditure on labour, the acreage cost is by far the lowest we have hitherto met with, but the fact that it is carrying very little stock, and that they are doing badly on it, makes this apparently cheap land really dear. It is capable of improvement and would pay for improve-

ment, but until something more is put into it, it will remain dear at the low rent which is at present being paid.

In contrast with this is the case of P.O.H., whose land stands on the Millstone Grit more than a thousand feet above sea level, most of it little more than moorland a few years ago. Originally sour, all the land is limed every fifth year. Originally more poverty stricken than that of J.H.S. it has been well dressed with the manure from well-fed cows, supplemented with judicious application of phosphates. At the present time this farm of 120 acres, ninety per cent. of which is grass, is carrying sixty-four cows, a hundred pigs and nearly two hundred head of poultry. While the acreage cost of the grazing is more than double that of J.H.S. its cost per unit of stock is 18 per cent. lower, the milk yield of his cows 38 per cent. higher, and the net returns from his farm *three and a half times as great.*

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ARTIFICIAL DRYING OF CROPS.

DURING the past year the Ministry commenced an investigation into the artificial drying of crops in the stack. The system is an old one, and has had considerable popularity from time to time, and has never lacked advocates; but against the instances of the successful use of the method there have been many more instances of failure. Nor have the advocates of the system spoken with one voice; some variant has been claimed as the key to success, but, unfortunately, the key never seemed to open every lock.

The successes and failures are, broadly speaking, explicable. Much depends upon the season: continued wet or a long dry spell is a condition which must be taken into account whether the crop is in the stack or in the field. Crops differ widely in texture and in the way in which they pack in the stack; meadow hay is a very different substance from clover hay; wheat, barley, oats, peas, all have marked characteristics. A single recipe is prima facie unlikely to be successful.

The first task clearly was to survey the field, to discover what was being done in actual practice by those who were satisfied with the method, and to fill in gaps by arranging for experiments with crops other than those already being treated. Observations were eventually taken on 21 stacks made up as follows:—

Meadow grass 3, red clover 3, white clover 1, clover and meadow grass 1, rye grass and red clover 1, rye and tares 2. Barley 4, oats 2. Peas 2, beans 1 and lucerne 1.

In its simplest terms the problem of artificial drying consists in the removal of surplus moisture and the control of tem-

FIG. 1.—A "Sirocco" Fan drying a Barley Stack.

FIG. 2.—A "Cyclone" Fan drying two stacks of Rye and Tares.

FIG. 3.—General view of Stack-yard, showing the form of Centre Chamber and Duct used.

peratures; actually it is not so simple as that, because, for example, the chemical and physical changes which are set up may affect the quality of the crop, and the condensation of moisture on the exterior of the stack, combined with heat, may produce conditions favourable to mould. However, if only surplus moisture can be removed quickly enough and the temperature kept below a point at which it would do harm, the problem is solved. This is in brief the argument for forcing a current of air through a stack by means of a fan driven at high speed by a motor.

Suppose we are set the problem of reducing freshly cut grass with a moisture content of, say, 70 per cent. to hay with a moisture content of 16 per cent. We do not propose to employ the usual process in the field—the weather is unfavourable. We know that a stack made of this crop with such a high moisture content (or indeed a very much smaller moisture content) will heat, and if the temperature is not controlled the crop will spoil and possibly the stack will fire. A current of air passing through the stack will not only remove moisture, but it will reduce the temperature by bringing cold external air into contact with the hot interior. The expulsion of the moisture which we do not want in our final product eventually removes the cause of heat as well.

This is the theory, but while we have been passing the air through the stack a number of other events may have occurred. The surrounding air may be damp and cold; it may not take up moisture sufficiently quickly when driven through the stack. Consequently, under such conditions the system will not be efficient.

It is not proposed now to describe in detail the methods adopted in drying the stacks under observation. There were certain general features common to all which will give sufficient indication of the system.

Before the crop was cut a central chamber and duct were constructed, and the stack was afterwards built in such a manner that, as far as possible, an equal resistance to the passage of air was offered around each part of the central chamber. The inlet duct constituted the channel by way of which the air delivered by the fan passed into the central chamber and ultimately through the stack into the open air.

Observations were taken from the time the crop was cut until the stack was dry enough to prevent further heating. The number of hours during which blowing was continued varied according to the nature and condition of the crop, size of central chamber

in relation to volume of stack, and the fan and power available.

With this method corn, bean and pea stacks were treated successfully. Two pea stacks in particular were dried very rapidly, and the peas were amongst the earliest on the market. A good price was obtained for these as they were of exceptionally good colour and free from wrinkles. In addition the whole of the pea straw was made available for fodder purposes. A case occurred where a barley crop was at first abandoned owing to its sodden condition and the inability to harvest it by ordinary means. With the artificial drying system, however, the crop was dried and a feeding sample of barley obtained.

The treatment of hay was not uniformly successful, chiefly owing to the growth of mould on any parts of the stacks where surface moisture had not been entirely removed. The close texture of hay added to the difficulty of removing moisture.

The experiments have afforded a great deal of information and have suggested lines of laboratory work which have been carried out with successful results. Until experiments with a modified system have been successfully tested in the field, however, no really valuable advice can be given to those who are anxious to make a trial of artificial drying. It certainly seems as though the simplest form of forced draught will dry peas successfully; but much still requires to be known, particularly as to the conditions under which hay can be dried. Because one crop has been successfully dried no would-be experimenter should imagine that other crops can be successfully dried under the same or different conditions. Farmers would be well advised to wait for a short time until more precise information is available, and full and definite directions can be drawn up for their guidance.

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AGRICULTURAL DISCUSSION SOCIETIES.

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CO-OPERATION is often mentioned at the present time as a means by which the business of agriculture may be made more profitable, and there is no doubt that in theory the principle of co-operation is one of the most satisfactory remedies for many of the difficulties with which farmers are faced during the prevailing agricultural depression. Co-operation for the common good is the basis of civilisation, and its intelligent application to the agricultural

industry in all its branches would, subject to the loyalty to each other of those engaged in the industry, go a long way towards its salvation.

Co-operation is generally understood to apply to the buying and selling of produce, but that is only a small part of its functions, there being many other directions in which the co-operation of agriculturists might benefit the industry. One field of co-operation which has been little explored is that of agricultural education.

Until recent years farmers have had considerable doubt as to the practical value of agricultural education and research. To-day conditions have largely altered. Research is constantly bringing to light new discoveries of very great practical importance to farmers. There is, however, still a gulf between the research worker and the farmer who should benefit from the research. The connecting link is generally the County Agricultural Organiser and his staff, but the Organiser works under many difficulties, and his time is largely taken up with administrative work and with endeavouring to break down the prejudice of farmers against agricultural education. If he succeeds in this a second difficulty awaits him, as the demand for agricultural education rapidly exceeds the supply and he finds himself unable to cope with it alone or with the limited staff generally available. It is possible to find a remedy for this state of affairs by the application of co-operation to agricultural education, by means of the formation of Agricultural Discussion Societies.

The members of such a society (farmers, landowners, farm workers and others) meet periodically to pool their experience and discuss methods by which their practical difficulties may be overcome. The objects may be briefly summarised as "the promotion of a healthy interest in all agricultural matters, both practical and scientific, by affording opportunities for the exchange of views on matters of importance, by means of lectures, discussions, demonstrations, visits to farms, and experiments, or by any other means which may be deemed advisable."

Unlike the usual system of education which aims at the teaching of young men who will be the farmers of the future, the Agricultural Discussion Society aims particularly at providing education for those actually engaged in farming. The lectures and discussions arranged deal, therefore, with the findings of research workers and the practical application of their results to the system of farming practised on the farms of the members themselves.

Formation of a Society.—In forming a society the method of procedure is to organise a lecture on some special subject to be given by an expert on that subject. This lecture should be of such a nature as to convince those present that there is something of practical value to be learnt from agricultural education and should make the audience ask for more. Provided the necessary enthusiasm is aroused, a President, Vice-Presidents, Secretary and Committee are appointed, and they in consultation with the Agricultural Organiser draw up the programme for the year. Lectures are arranged either weekly, fortnightly or monthly during the winter months, and are given by members of the County and Agricultural College staffs, experts from the Ministry of Agriculture, veterinary surgeons, practical farmers and others who are in any way connected with the industry.

Some idea of the scope of the work may be gained from the following example:—In Devon, which has now seven societies, lectures have been given by nine members of the county agricultural staff, five members of the staff of the Ministry of Agriculture, six members of the staff of the Seale-Hayne Agricultural College, thirteen local farmers and thirteen other lecturers. The 70 lectures dealt with such subjects as improvement of grass land, seeds mixtures, lime, poultry keeping, Devon cattle, farm accounts, veterinary first aid, the bacon industry, pig feeding, agricultural law, farm valuations and assessments, feeding of dairy cows, weeds and their destruction, farm implements and machinery, etc. In the summer lectures are not given, but trips are arranged to farms and experimental stations in the county and outside.

The first society was established by the writer at Brompton, near Northallerton, Yorks, 1921, and is still functioning successfully. Similar societies have recently been formed in other counties.

It is seldom desirable to form a society unless fifty members can be obtained, and these members should pay a subscription of from 1s. to 3s. to cover local expenses for hire of room, etc., and to ensure that only those who are interested shall obtain the privileges of membership.

Combined Meetings of Societies.—A further stage is the combination of societies in prescribed areas. If societies are formed at distances of 5 to 10 miles from a central society it becomes possible to hold occasional combined meetings, thus getting together audiences of several hundreds, with the

result that special lecturers may be brought into the county. This also enables an exchange to be worked between neighbouring County Organisers, and as a consequence much good results to the work of the counties concerned.

A large number of experimental and demonstration plots are laid down on the farms of members of the societies, and it is possible to arrange periodical demonstrations on these plots for the benefit of the members. During 1923 a party of 120 farmers from four societies visited H.R.H. the Prince of Wales' farms in Cornwall, and a party of over 80 farmers visited experimental plots in East Devon on 8 farms, during an afternoon in August.

Proceedings at Meetings.—The lecturer at a Discussion Society meeting lectures on his special subject. The lecture may last an hour or an hour and a half, and should be followed by a discussion which may be of equal duration. In this discussion questions should be asked the lecturer, who should reply to them as soon as they are asked, and other members of the society may support or differ from his answers. The discussion should not be confined to the asking and answering of questions, but should rather be an effort on the part of members of the society to arrive at a solution of the problems under discussion. Where doubt exists on any point, arrangements may be made to carry out experimental work.

As a rule the best and most lively discussions occur after lectures by farmers, as there are invariably a great many things practised by a farmer of experience which do not possess any scientific foundation, and on which other farmers no less practical will hold entirely different views.

The value of these societies lies to a large extent in the part which the members take in their own education, and in the fact that the instruction given through the societies is carried on for a number of years, and is not, as in the case of a course of lectures, finished at the end of one season. The result of this is that the members of the societies are able to judge on their own farms of the success or otherwise of the instruction given and are also able to state their experiences of new methods at meetings of the societies held in after years. Members of societies not only attend with the object of learning but are also expected to assist in furthering the instruction provided, and the more they disagree with the lecturer the better the discussion and the greater the educational value. The mixing of old and young farmers, together with farm

workers and land-owners, brings many different points of view to bear on problems under discussion. The young farmers speedily gain information from the older ones present, while the older ones realise that the young men do not intend to be satisfied that the practices of their fathers are correct without first testing the value of the new methods advocated.

As far as the County Organiser is concerned, he will find that the running of a society results in great economy in the work of his staff, and consequently a far greater amount of work can be accomplished with the staff available. The variety of subjects dealt with, and the variety of lecturers, are additional advantages, and help to maintain interest. The discussions at meetings of these societies form a very useful means of training young farmers in public speaking, an important matter in these days of active Farmers' Unions.

From a scientific point of view, the Agricultural Discussion Society forms an excellent link between the farmer and the scientist. Discussions on many occasions bring to light differences of opinion amongst practical farmers which call for further investigation by the scientist. Societies also provide a convenient medium for the distribution of pamphlets and other published information.

The writer looks forward to the time when every county will have its Discussion Societies, and when every important agricultural district in each county will have a society. Judging by the success of the societies already established, great progress in agricultural education will be made when this state of affairs is brought about. The Farmers' Unions, which have done such good work for the agricultural industry generally, cannot afford to miss this opportunity to increase their power for good by bringing their members into closer contact with each other.

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METHODS OF COVERING GRASS SEEDS.

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THE results of previous investigations on the depth of covering best suited to the seeds of various grasses and clovers, and as to the methods of covering most applicable to ordinary field conditions have been published in this *Journal*.*

* *Depth of Sowing Grass and Clover Seeds*, by R. D. Williams, April and May, 1922; *Methods of Covering Grass and Clover Seeds*, by R. D. Williams, March, 1923.

In order to throw more light on this important practical problem and to make the investigations more comprehensive, a further series of experiments was carried out in 1923 on the methods of covering the seeds of perennial rye grass, meadow foxtail, timothy and rough-stalked meadow grass.

It is often recommended that the large and small seeds constituting a mixture should be sown separately, and that the large seeds should be harrowed in before sowing the small seeds, which should be left on the surface or merely rolled in. On *a priori* grounds this view seems quite sound, since seeds of different grasses and clovers have different depth requirements.

In order to ascertain if this is the case in actual practice, representative grasses with large seeds (perennial rye grass and meadow foxtail) and others with small seeds (timothy and rough-stalked meadow grass) were selected for the experiments here dealt with. The trials were carried out on a fairly uniform medium loam which had carried an oat crop in 1922. The soil was in good condition and an excellent seed bed was obtained. The seeds were sown broadcast by hand on 16th June, without a nurse crop, on long narrow one-hundredth acre plots, 72.6 feet long by 6 feet wide.

The seeds were covered by farm implements commonly used for the purpose. The methods of covering adopted were:—

(1) Seeds uncovered; (2) Smooth roller; (3) Horse hay-rake, followed by smooth roller; (4) Chain-harrow, followed by smooth roller; and (5) Light peg-harrow, followed by smooth roller. Each species was sown on 20 plots, 4 plots being allocated to each method of covering, of which two were chain-harrowed and two rolled as the last operation before sowing.

The four species were sown at the uniform rate of four million viable seeds per acre, that is, at the rate of 91.8 viable seeds per square foot. The percentage (laboratory) germination of the seeds of each species was as follows: perennial rye grass 94, meadow foxtail 92, timothy 98 and rough-stalked meadow grass 78.

The seedlings were counted on 11th to 16th August by taking 40 readings per plot with 6 inch meshes. These results are summarised in Table 1 hereunder, which shows the average number of seedlings per square foot of perennial rye grass, meadow foxtail, timothy and rough-stalked meadow grass on plots covered by different methods.

TABLE I.

Last operation before Sowing.	Method of Covering.	Perennial Rye Grass.		Meadow Foxtail.		Timothy.		Rough-stalked Meadow Grass.	
		Seedlings.	Probable Error.	Seedlings.	Probable Error.	Seedlings.	Probable Error.	Seedlings.	Probable Error.
Chain-harrowed	1	12·0	± 0·43	3·1	± 0·29	12·0	± 1·72	14·0	± 0·55
	2	16·9	± 0·57	7·0	± 1·26	21·0	± 1·86	21·9	± 1·00
	3	27·5	± 0·72	9·4	± 0·83	25·6	± 0·26	20·6	± 2·19
	4	44·7	± 1·57	14·0	± 0·88	33·7	± 0·57	25·5	± 1·74
	5	42·2	± 2·41	15·5	± 2·27	23·6	± 0·17	20·7	± 0·14
Rolled	1	9·7	± 0·48	4·1	± 0·38	11·6	± 0·62	13·8	± 0·86
	2	15·4	± 0·86	5·2	± 1·03	20·3	± 1·57	20·9	± 0·21
	3	26·1	± 1·05	7·3	± 1·12	15·1	± 1·84	22·8	± 0·72
	4	41·6	± 1·62	9·6	± 0·74	21·2	± 0·93	23·7	± 0·88
	5	41·8	± 1·67	8·5	± 0·29	16·4	± 1·19	22·3	± 0·74

The average depth at which the majority of the seeds were covered by the different implements was as follows: roller $\frac{1}{8}$ in., hay rake $\frac{1}{4}$ in., chain-harrow $\frac{1}{2}$ in., peg-harrow $\frac{1}{2}$ in.

Discussion of Results.—*Perennial Rye Grass.*—It will be seen from the figures in the Table that the plots covered by the chain and peg-harrows gave very similar results. These plots had far better stands than the plots covered by the other methods. The uncovered plots had only about 28 per cent., while those covered by the roller and horse-rake had only 38 per cent. and 62 per cent. respectively of the number of seedlings found on the chain-harrowed plots.

It will also be seen that the plots sown on a chain-harrowed surface gave in every case slightly better takes than the corresponding plots which had been rolled prior to sowing, but the differences are probably too small to be of practical significance.

Meadow Foxtail.—As in the case of perennial rye grass there was very little to choose between the peg and chain-harrows as implements for covering meadow foxtail. Both these methods resulted in better takes than any of the other methods of covering. On the plots chain-harrowed before sowing, the number of seedlings on the uncovered plots was only 21 per cent., on the rolled plots 50 per cent., and on the raked plots 61 per cent. of the number counted on the chain-harrowed plots.

The strikingly low figures obtained for this grass under all methods of covering are, no doubt, largely accounted for by the fact that the seeds were not properly covered by any of the methods, for even when covered by means of the peg- and chain-harrows a much larger proportion of meadow foxtail seeds was left exposed than was the case in any of the other seeds experi-

mented with. In this connection it is interesting to note that the figures in the table show that rolling the plots before sowing did not give rise to as satisfactory takes as on the chain-harrowed surface. For instance, the plots rolled before sowing and then covered by the peg-harrow had only 56 per cent. of the number of seedlings counted on the corresponding plots which had been chain-harrowed before sowing. The greater resistance offered by the rolled surface to the large and very light meadow foxtail seed probably explains the inferiority of the plots so treated.

Timothy.—The data obtained for timothy seem to suggest that the small plump seeds of this grass were covered too deeply by the peg-harrow. The best results were given by the chain-harrowed plots. The uncovered plots and the plots covered by roller only were again poor.

The raked, chain-harrowed and peg-harrowed plots which had been rolled before sowing had, for reasons which cannot be explained, much poorer stands than the corresponding plots which had been chain-harrowed before sowing.

Rough-stalked Meadow Grass.—The stands of rough-stalked meadow grass were not nearly so much influenced by the methods of covering as the other three grasses. Although the best results were obtained, as in the case of perennial rye grass, timothy and meadow foxtail, on plots covered by the chain-harrow, yet even the uncovered plots had 55 per cent., while the rolled plots had 86 per cent. of the number of seedlings on the chain-harrowed plots.

Despite the fact that all the rough-stalked meadow grass plots gave very poor results relative to the number of viable seeds sown, nevertheless the figures given in Table I are undoubtedly too high as they include a certain proportion of indigenous plants obtained from self-sown seeds. This is proved, for example, by the fact that the meadow foxtail plots had on the average as many as 7 seedlings per square foot of self-established rough-stalked meadow grass.

Conclusions.—The results of these experiments show quite definitely that chain- and peg-harrowings were by far the most effective methods for covering the large seeds of perennial rye grass and meadow foxtail. These results agree very closely with the results of previous investigations already referred to, in which it was shown that the best takes of Italian rye grass, cocksfoot and red and white clovers were obtained when the seeds were covered by these two implements.

Moreover, the results indicate, for the conditions under

such as timothy and rough-stalked meadow grass have to be thoroughly covered in order to give the most satisfactory stands. Both timothy and rough-stalked meadow grass produced poorer takes when the seeds were left uncovered or merely rolled in than when they were chain-harrowed. The rapidity with which the delicate root-hairs of the exposed seedlings are dried up is, no doubt, mainly responsible for the comparative failures of the seeds not properly covered.

The most satisfactory takes of timothy and rough-stalked meadow grass were obtained by covering the seeds by means of the chain-harrow. The tendency of the peg-harrow was to cover these small seeds too deeply. The horse hay-rake, although it gave better results than the roller, was an inferior implement to the chain-harrow for covering both large and small seeds.

As will be seen from the figures given below, there was a wide discrepancy in the case of each species between the number of viable seeds sown and the number of established seedlings, even on the plots with the best takes:—

	Number of Seedlings per square foot on the best Plots.	*Ratio of Seedlings per square foot to viable Seeds sown.*
		Per cent.
Perennial Rye Grass... ...	44·7	48·7
Meadow Foxtail	15·5	16·9
Timothy	33·7	35·8
Rough-stalked Meadow Grass	23·7*	25·8*

The number of viable seeds sown in each case was 91·8 per square foot.

Thus within so short a period as two months from sowing the number of established seedlings of perennial rye grass was less than one-half, timothy about one-third, meadow foxtail less than one-fifth, and rough-stalked meadow grass about one-quarter of the number of viable seeds sown.

It is beyond the scope of this paper to inquire into the causes for the very heavy soil casualties which have been shown to occur. It would seem to be indicated, however, that although laboratory germination figures afford a valuable index as to the viability of seed, they do not necessarily afford much guidance as to the behaviour of the seed under field conditions of germination and establishment. Notes taken on the plots suggest, however, that slugs and other small soil fauna are undoubtedly responsible for a part at least of the casualties, and this is one aspect of the case demanding further inquiry.

Summary.—The evidence discussed here and in the papers previously published may be summarised briefly as follows.

* These figures include a certain number of self-established seedlings and are therefore too high.

It should be emphasised, however, that these general conclusions apply only to the species and implements tested, and that they do not necessarily hold good for other grasses and clovers, and other methods of covering.

(1) It has been shown that good takes of the grasses and clovers tested depend very largely upon the thoroughness with which the seeds are covered. Even the small seeds of timothy and rough-stalked meadow grass have given far better takes when harrowed in than when left on the surface or when merely rolled in.

(2) Of the implements employed the best for covering the large seeds of Italian rye grass, perennial rye grass, cocksfoot, meadow foxtail and red and white clovers were the peg and chain-harrows. These two implements gave about equally good results.

(3) The chain-harrow proved a better implement for covering small seeds than the peg-harrow.

(4) The horse hay-rake and the Cambridge roller did not give as reliable results as the harrows.

(5) Apparently there is no advantage to be gained by sowing the large and small seeds of a mixture separately, provided the seeds are covered by the chain-harrow.

(6) Although the differences between the results of the two pre-sowing operations were in most cases small, yet the plots which were chain-harrowed as the last operation before sowing gave, on the whole, slightly better stands than the plots which had been rolled immediately before sowing.

(7) There was a very considerable but an unaccountable loss of viable seeds amounting to about four-fifths of the seeds sown in the case of meadow foxtail and rough-stalked meadow grass, even when the seeds were covered by the most effective implement, namely, the chain-harrow.

In conclusion the writer's grateful acknowledgments are due to Messrs. W. Davies, B.Sc., C. Jones, B.Sc., J. G. Davies, D. E. Milton and G. Evans, B.Sc., for valuable assistance in making the numerous readings.

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SWEDE AND TURNIP SEED GROWING IN KENT.

CHARLES CREERY.

AN account appeared in this *Journal* for July, 1923, p. 353, of turnip, swede and mangold seed growing in Lincolnshire. In the famous Romney Marsh district of Kent, where a large acreage,

chiefly swedes, is grown, the methods of growing, harvesting and thrashing are so different, that it may be of interest to compare the two systems. Each is no doubt the most suitable to the respective district. Swede and turnip seed, grown in these Marshes, have a great reputation for their keeping qualities. Only a small acreage of turnip seed is now grown in Romney Marsh. Many farmers prefer it to swede, as it comes earlier, and is less liable to "canker" and to attacks of the "fly" or flea beetle, but the price to the grower is less than for swede seed.

The same methods of cultivation are adopted for both turnip and swede seed.

Seed and Sowing.—In Romney Marsh, the crops for seed purposes are seldom drilled to stand. The plants in almost every case are grown outside the Marsh area, usually on the higher ground to the north of the old Royal Military Canal, between Rye on the west and Hythe on the east. Some are grown at considerable distances from the seed district, and are brought by motor transport, which, though more expensive, is preferred by many.

The most suitable ground is either a fallow or after early potatoes. For swede seed the best land is that which has been broken up recently; heavy crops can be grown for many years with proper rotation.

The stock seed for the plants should be sown about the middle of August; unless the weather is very favourable, great risk is run if sown later than the third week in that month. If dry weather sets in, the plants may be some time coming, and until the third leaf is developed they are in danger from frost. Turnip seed may be sown rather later than swede.

To grow plants satisfactorily, the ground should be thoroughly cleaned, and a fine seed bed prepared. As much care is necessary as with any other crop, but this is not always recognised.

The stock seed for the plants is sent by the seedsmen to the farmer, with whom they have contracted to grow the seed at a price per cwt.; and he forwards it to the man who is to grow the plants for him at so much per acre planted. One gallon of stock seed is sufficient in an average season for 5 to 7 acres of plants. The seed is sown either broadcast or by seed barrow, and covered in by harrows, sometimes followed by a light roller. Broadcasting seems still to be the most reliable method, as a more even plant is obtained, if done by experienced men.

Planting and Cultivation.—If the weather is suitable, and it has been possible to get the ground ready, the plants should

be set out about the middle of November. Plants one inch in circumference are a fair size. Planting can go on continuously from November until the end of February, unless the ground is very wet or hard. It is not advisable to plant later than this. The distance between rows should be about 2 ft., and the plants dibbled in from 12 to 15 inches apart.

Cross harrowing and rolling often help the plants before they reach any size if attacked by slugs or wireworms. As soon as weeds appear the ground requires shimming and hoeing. The shim cannot be used too often, until the plants are ready to earth up about the latter part of April. After this is done they can be left to take care of themselves.

The majority of growers in this district favour topping, or cutting back about 6 inches, before the plants commence to bloom. If they are inclined to run up this checks them and helps them to branch out. The need for this does not always arise, but in most cases it is the practice.

Rogueing, *i.e.*, taking out the false plants, requires special attention, in order to keep the stock true. Amongst swedes, a turnip, or some bastard swede, will be distinguished by its bright yellow flower. In many cases the farmer will take these out as he comes across them. It is, however, usual for the seed merchants to send their own experienced men to do this work, as often it is only by a slight difference in the colour of the bloom and the lower part of the stem that rogues can be detected.

Cutting and Thrashing.—Cutting takes place towards the latter part of July for swedes. Turnips may be three weeks earlier. The pods should have a good purple brown colour when ready. Some farmers are inclined to cut rather too soon, but in certain seasons it is very difficult to judge exactly the right moment. The tops are cut off about eighteen inches from the ground and laid carefully in rows.

Thrashing will commence in from ten days to a fortnight afterwards, according to the weather, but the seed must be quite ripe or it will not keep well and its value is reduced.

A large sailcloth is laid out in the field, and pegged down, with the sides slightly raised. Sledges on runners or small wheels are then drawn between the rows, and the straw picked up very carefully and placed in the sledge with tops inwards to avoid seed scattering. They are then turned over on to the cloth, and the straw arranged in a circle. A light horse roll is taken round over it, and the straw shaken out by men with forks as the roll passes. This appears a rather primitive way of thrashing, but it is quite effective. It has one great

advantage over a machine—there is no fear of seed getting mixed. With a machine, unless the greatest care is taken in cleaning, much trouble may arise after each different sort is thrashed.

When thrashed, the seed is put through a blower on the ground and then taken to the granary where it is cleaned.

Diseases and Pests.—"Canker" is the name locally in use for a disease which possibly starts in the plant bed. It is not as a rule noticed until the plants are fit to hoe, about the second week in March. The first sign is a slight bluish tinge in the leaf; and if the hoe touches it, the plant will probably break off. If a plant is pulled up with care there may be nothing to indicate disease, but on cutting through from the crown downwards the rot is exposed. Plants affected in this manner have been known to hold out until cut, if well earthed up, but in high winds they usually fall.

Snails and wireworms frequently eat into the smaller plants, just below the surface of the ground. This in time causes rot, and is often mistaken for canker.

Maggot or "bladder" is in evidence every year in the pods, often causing a loss of 20 per cent. in the yield of seed. Last year, although every other pest was abundant, the pods affected by maggot were negligible: they had not been so free for many years.

Rooks may do considerable damage to young plants, pulling out whole rows in search of wireworms. Linnets and doves take a heavy toll just before the seed is ready to cut.

Flower beetles are without doubt, the greatest enemy to the swede flower, and the most difficult to attack with any success. It is always present to some extent when plants are in bloom. For several years it has done serious injury, and in 1922 it destroyed almost the entire crop. Nothing has yet been found that is of real practical use against it.

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ORGANISED DAY COURSES IN AGRICULTURE.

THERE are throughout the country a large number of young farmers, farmers' sons, and other persons interested in agriculture for whom, owing to considerations of time and money, a course at an agricultural college or farm institute is impossible. Such persons are a distinct class demanding special consideration on the part of those responsible for providing educational facilities, since such time as they can devote to instruction

is, by reason of their environment and occupation, both limited and seasonal. It is for such students, of ages mainly from 16 to 35, that Organised Day Courses are primarily designed, and such courses are being successfully conducted at various centres. The object of this article is to outline a course adapted to meet the average demand. Suitable modifications will suggest themselves in connection with, for example, the type or sex of student attending such classes.

The question arises as to how far the substance of the courses of one to three years at an agricultural college can be modified to meet the needs of organised classes such as are here contemplated. Such teaching usually progresses from the fundamental pure sciences through their applied aspects to the unifying subject of agriculture which interweaves these different scientific threads with farm management and business methods.

In addition to the imparting of facts it is the object of the teacher to develop powers of observation and the faculty of thinking clearly, and, if this educational return is to be obtained in a course that has to deal largely with matters of immediate practical application, the isolation of facts and even sectional treatment of the subject must as far possible be avoided.

Though the standpoint of the teacher in an Organised Day Course must differ from that of one engaged at a college or institute, and though considerations of time will limit his selection of material, yet the fundamental truths he must seek to inculcate are the same as in a course of greater pretensions. They are, shorn of all elaboration, the story, simply told, of how a plant grows and how an animal lives. The teacher should remember, too, that he is not only instructing young farmers in the reasons for their practice, but is also explaining farming as a business and pointing the way to improvement. By the selection of matter that is of immediate local interest, not only is the necessary confidence established between teacher and pupil, but attention is directed to all aspects of the system of farming common to the district.

The basis of teaching should be the system of farming practised in the given locality, and, following on the simple discussion of the elementary scientific and economic principles underlying farm practice, the development of a broad co-ordinated view of the business of farming as a whole should be attempted. The business side of the industry should always be kept to the forefront, the influence of fundamental financial

considerations on the practice and conduct of the farm should be demonstrated, and such alternatives should be suggested as can be justified on economic and scientific grounds.

In the following pages an attempt is made to apply the general principles stated above to the framing of a syllabus for a suitable course in agriculture. Allied subjects such as horticulture, dairying and poultry-keeping, except in so far as they come within the range of mixed farming, are not included. The treatment of these subjects in detail would not be generally advisable or possible in these classes, and must necessarily be reserved for special courses as occasion demands. Nevertheless, in the course of general lectures, indications would be given of lines likely to be profitable locally, and therefore deserving of supplementary courses. Comprehensive syllabuses of certain specialised branches of farming are included in the addenda as suggestions for adoption where a demand for instruction in these may exist or arise.

While there is no desire to interfere with the discretion of the teacher, or with local requirements, it may be stated that a convenient arrangement has been found to be one day of four to five hours a week at each centre for a period of twelve to thirteen weeks, and the number of students should not exceed twenty.

The course may be classified under the three heads, A. Crop Husbandry; B. Animal Husbandry; and C. Farm Management. These are dealt with below.

A. Crop Husbandry.

(*a*) *The Soil.*—Origin and properties of soils; examination of the different soils and subsoils with special reference to local types (arable and pasture); sandy, clayey, peaty, and chalky soils; temperature and aeration of soils; soil moisture; soil bacteria.

(*b*) *Principles of Cultivation.*—Effects of ploughing, harrowing, rolling, etc., preparation of seed bed; modifications of the soil; draining, sub-soiling, bare fallowing, cultivating; liming; manures, natural and artificial.

(*c*) *The Plant.*—The structure of the plant; essentials of plant growth—air, water, food, heat (leading up to a general consideration of farm crops from an elementary botanical standpoint); cereals, pulses, roots, grasses and clovers.

(*d*) *Principles of Rotations.*—Inter-relationship of cropping and stocking with special reference to the system prevailing locally; crops of the rotation dealt with individually—their cultivation, manuring, harvesting and disposal.

Weeds, and their eradication.

Grassland—valuable, useless, and harmful plants in meadows and pastures; management.

B. Animal Husbandry.

(*a*) Elementary physiology and anatomy of different classes of stock; principles of breeding, rearing, and feeding, management in health and disease.

(*b*) Types of animals.—(1) The horse—faults in leg and feet. Shoeing; (2) Cattle—dairy stock and beef cattle; (3) Sheep; (4) Pigs.

(*c*) Feeding and management of live stock, compilation of rations, and economic use of purchased and home-grown foods; milk recording; improved methods of meat and milk production.

C. Farm Management.

(*a*) Business principles; use of farm diary and records; book-keeping, simple accounts, cash analysis system, preparation of Profit and Loss Account, the Balance Sheet; income tax assessment, basis of rating and taxation; method of determination of costs of production; valuation of manures, feeding stuffs and unexhausted residues; farm arithmetic and elementary surveying.

(*b*) Law of Landlord and Tenant; Farm Capital; Tenant Right Valuation—basis and method, and custom of the county.

(*c*) Co-operation, distribution and supply.

(*d*) Machinery and care of implements.

(*e*) Organisation of labour.

(*f*) Production costs.

It is not suggested that all instruction should be given in the form of lectures. Excursions to neighbouring farms should be made, thus giving the teacher the opportunity of illustrating his teaching and encouraging discussion and inquiry amongst the students.

It is neither possible nor desirable to teach manual processes otherwise than by demonstration of methods and recognition of good and efficient workmanship. The training of a skilled worker is as much a question of time and practice as of instruction.

HORTICULTURAL SYLLABUS.

Study of the Plant.—General structure; functions of leaves, roots, stems and flowers; nutrition, assimilation, respiration, transpiration, growth; essential conditions for growth; seeds and their germination.

The Soil.—Its composition, properties, kinds; water supply; plant food; the principles of manuring, farmyard manure, artificial manures; cultivation.

Pests.—An introduction to the study of fungi and insects; life history of a few common pests.

Vegetables.—Kinds, main points in cultivation; rotation; manuring; production of early and late crops.

Fruit.—Kinds; recognised market varieties; general cultivation and treatment; stocks; propagation; grading; packing and marketing.

Crops under glass.—Crops suitable for cold frame, houses, etc.; main points in the cultivation of tomatoes, cucumbers, etc.

Flowers.—The best market kinds—daffodils, sweet peas, wallflowers, chrysanthemums and carnations.

DAIRYING SYLLABUS.

1. *Importance of Cleanliness in Dairying.*—Contamination—(*a*) Visible, (*b*) Bacterial; preventive methods.

Bacteria, ferments and enzymes in milk; harmful and beneficial kinds; how they help or defeat the cheesemaker; rate of increase (1 into 2 in 20 minutes—calculate number in 24 hours).

Means of checking action—(*a*) Pasteurisation, sterilization and refrigeration.

Material required.—Diagrams of different forms of bacteria; explain minuteness, will pass through strainer; explain action in producing starter and gassy curd.

2. *Methods of Handling Milk.*—(*a*) Cowshed, clean, light, and well ventilated; (*b*) cows' hindquarters clipped, groomed and washed; (*c*) milkers' hands and clothes clean; (*d*) utensils clean and sterile; (*e*) cooling; (*f*) strainers, cotton pads.

Material required. — Pamphlet showing simple steam sterilizer; glass flask and Bunsen burner or other heating arrangement; photographs illustrating the methods adopted when clean milk production is practised.

By means of a special thermometer show difference in temperature between hot, scalding and boiling water.

3. *Dairy Appliances.*—Milking; buttermaking; separator; cheesemaking; testing; chemicals and glassware; defects in utensils and effect on milk; care of utensils; thermometers.

Material required.—Dairy catalogues in which to point out the various utensils and discuss the material of which they are made, and their advantages or disadvantages for the purpose for which they are designed.

4. *Milk.*—Properties and composition of whole milk, separated milk and cream; effect of heat and rennet on milk; law regarding milk; grading.

Material required.—2 glass jars; some rennet and Bunsen flame or other means of heating. Experiment—Almost fill jars with milk and to one of them add rennet and show separation into curds and whey; apply heat to the other jar and observe results. Explain pasteurisation and sterilization.

5. *Milk Products.*—Cream, butter, cheese, their composition, manufacture and marketing; marketing of milk.

Material required.—Small portion of starter, discuss its use in cheese and butter-making; cream containers, butter paper and cartons, cheese calico. If facilities available take a fat test of milk and cream.

6. *Food Values of Milk and Milk Products.*—Comparison with beef, potatoes, fruit; value of milk for children and invalids; necessity for care in handling; wastage due to improper handling; various dishes which can be prepared from milk and milk products.

Material required.—Chart showing comparative food values of various substances; add rennet to milk to make junket, give recipes for various dishes.

7. *Milk Testing.*—Analysis; acidity; visible dirt content; bacterial content.

Material required.—Gerber tester and chemicals; acidimeter and chemicals; Gerber dirt tester; petrie dish; lactometer and thermometer; slide rule.

Take test for fat content and calculate total solids by means of lactometer, reading by means of slide rule; take tests for acidity and explain function of neutralizer and indicator; take test for visible dirt; show prepared petrie dish and discuss method of preparation.

8. *Breeds of Dairy Cows.*—Points of dairy cow; udder and milk vein; diseases of udder and how they affect the milk supply; washing hands after milking each cow as a means of preventing transmission of diseases.

Material required.—Charts of 3 or 4 breeds of dairy cows; chart showing points of typical dairy cow; anatomical chart of udder.

SMALL LIVE STOCK SYLLABUS.

Poultry on the Farm.—System of management; destruction of insect pests; improvement of grassland; value of manure.

Breeding of Fowls.—Suitable varieties; breeding; selection; management.

Feeding.—Utilisation of farm products; feeding for egg production; fattening.

Incubation.—Natural methods; use and management of an incubator.

Rearing of Poultry.—Artificial brooding; feeding chickens; treatment of young stock; ducklings.

Housing of Poultry.—General principles; suitable types; materials and construction; temporary shelters; general equipment.

Duck Keeping and the Breeding of Geese.—Egg production; table ducks; rearing of goslings.

Turkey Breeding.

Common Disease of Poultry.—Prevention and treatment; roup; disease of the liver; gapes; intestinal diseases in chickens.

Goat and Rabbit Keeping.—Value to the farm labourer; breeding and management of goats; fur production from rabbits; management.

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WATERCRESS AND ITS CULTIVATION.

A. H. HOARE,

Ministry of Agriculture and Fisheries.

THE value of watercress in the national dietary was emphasised at the last meeting of the British Medical Association. In addition to the already established medicinal properties derived from its oily and mineral contents, it possesses, in common with other green salad plants and with fresh fruit, an important value from the point of view of general nutrition, since it is a source of those active chemical bodies known as vitamines which appear to play a vital part in healthy nutrition.

Apart from the fact that watercress should be readily obtainable all the year round, it has the further advantage over other salad crops that it is cheap enough to be within the reach of everyone. Such a source of healthy green food should not, therefore, be neglected, and the following notes upon the plant

and its cultivation may be of some assistance in stimulating its production in this country.

Watercress (*Nasturtium officinale*) is a cruciferous aquatic plant, and is indigenous to Great Britain as well as the rest of Europe and Asiatic Russia. It has also spread to Northern America and has established itself in many of the British Colonies.

As an edible plant it has been recognised almost as far back as history records, and is frequently referred to by writers of the Greek Classical Age under the name "*Kardamon*," and was regarded as a remedy for brain disorders, as the name, meaning "head subduer," implies.

The plant appears to have come under cultivation in this country about the year 1800, and to-day practically all the watercress placed on the market has been cultivated in specially constructed watercress beds.

The Plant: Description of Types.—Although all are derived from the natural species, there are three distinct varieties of watercress in cultivation. All three are a great improvement upon the wild plant, both as regards form and flavour. They are known to growers as dark green summer cress, light green summer cress and brown winter cress.

The two summer cresses are the varieties grown during the warmer months. They are both less hardy than the brown cress. The *Dark green summer cress* possesses leaves which are larger and bolder, with darker colour and fuller flavour and being less astringent than the light green variety. It also sells better and is the stronger growing type. The *Light green summer cress* more closely approaches the wild species in general aspect, but its flavour is considerably superior. It finds a ready sale on some markets.

The *Brown winter cress* is readily distinguishable, the green of the leaves being tinged with brown, particularly towards the edges. This browning becomes more marked in colder weather. This cress is mostly grown during the winter months, partly because it is hardier and partly because the market appears to demand a brown cress at this season of the year.

In commencing to cultivate watercress it is important to bear in mind these points as regards the varieties, and to make certain when purchasing stock that it is true to type. It is always best to go to a reliable grower for new stock, and to be certain beforehand which variety it is proposed to grow.

Cultivation: Water Supply.—The most important factor in successful watercress cultivation is the water supply. In the first place, whatever its source, the water must be absolutely

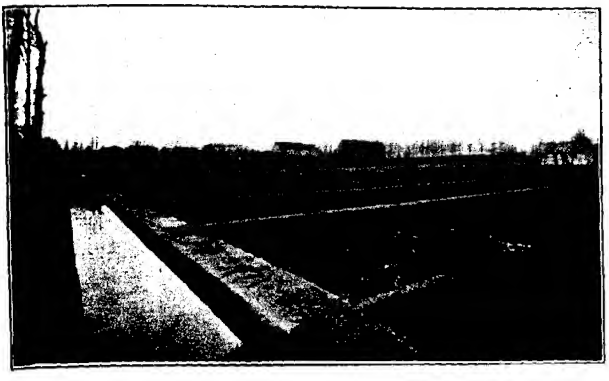

FIG. 1.—Modern Watercress Bed adjoining the River Wandle, near Wallington, Surrey, showing the Water Reservoir and light railway for transport of cress.

FIG. 2.—Showing the general lay out of a Watercress Bed, with packing shed in the centre.

free from contamination of any kind, and scrupulous care must be taken by the grower to guard against this occurring as long as the crop is under cultivation. For this reason streams of clear running water are usually employed, and as near as possible to their sources. An instance of this is the river Wandle in Surrey, which in its upper reaches is the source of water supply to several hundred acres of watercress beds.

Secondly, as it is impossible to grow watercress in the winter months with stream water, it will be necessary, if regular winter production is aimed at, to have access to a supply of spring water either on the spot or in close proximity to the beds. These points are not generally realized, but are important. The growth of watercress is mainly influenced by the temperature of the water. Stream water falls in temperature with the air, and at average winter temperature is useless for productive cultivation. On the other hand, spring water comes from the ground at an average temperature of about 48 deg. F. throughout the year and, providing it is kept under cover between its source and the beds, renders winter production a commercial proposition.

For the above reasons, therefore, watercress growers usually locate their beds by the side of shallow, quick-running streams near their sources and, if regular production throughout the year is desired, in localities possessing the principal water-bearing formations, such as the Chalk, the Greensands and New Red Sandstone.

If there are no available natural springs which may be utilised, deep bore holes are made into the water-bearing formation, and the "artesian wells" which are the result of these operations provide a constant and regular flow of water at a suitable temperature. Operations of this nature may be seen at Gomshall, in Surrey, where some of the largest areas of watercress beds in the south of England are located.

It is, of course, impracticable to make borings for water remote from watercourses, as the ultimate disposal of the water must be provided for whatever its source.

Before leaving the subject of water supply, references should be made to the fact that success or failure in watercress growing is often influenced considerably by the chemical nature of the water itself. Not all waters prove to be suitable, and in some the crop may refuse to grow altogether. This is due to the amount and assortment of minerals dissolved in the water, and spring water is particularly liable to variation in this respect. There are no definite data available upon this point, and beyond

stating that a prospective grower should experiment on a small scale at the commencement, if there be any doubt, little can be said. A survey of some of the most successful watercress beds in the Home Counties points to the fact that water from the Chalk and Greensand formations is usually dependable.

Construction of Beds.—The construction of modern watercress beds is a big undertaking involving the outlay of a considerable amount of capital. While it is quite possible to construct beds on cheaper lines by employing rough and ready methods, experience has shown that this practice is more expensive in the long run. The cheaply constructed beds will probably require continuous patching to maintain them in an efficient condition, while, on the other hand, the well-constructed beds last in good condition for a long period. Apart from these considerations the cheaper beds, constructed as they usually are from rough timber and turf, afford greater facilities for the attacks of watercress pests.

It will save time and expense, therefore, if walls and footways are constructed of strong concrete on good foundations and the surfaces should be rendered smooth in finishing. A watercress bed should be about 25 ft. or 30 ft. in width and of convenient length to suit the site. The length should not, however, be more than about ten times the width.

The walls on either side, which will also provide footways, should be about 2 ft. in height and 18 in. width. At the head of the bed a strong reservoir is constructed and separated from it by a wall from 2 ft. to 3 ft. wide. This reservoir should be about 4 ft. or 5 ft. in width and 2 ft. in depth, and serves to maintain a sufficient head of water to keep the adjacent bed supplied. One feed pipe is provided and so arranged as to bring the water flow to the bed under absolute control. The water is fed into the reservoir direct from the supply and there must be provision for control and overflow. The surface of the bed should be about 1 ft. below the top of the wall and so made as to provide a gradual fall throughout its whole length in the direction of the flow. The wall at the end of the bed should be suitably provided with an outlet pipe.

Winter beds should, if possible, be narrower and shorter than summer beds, bearing in mind that the cooling down of the water will affect the growth of the crop. The water supply must also be kept under cover except when actually in the bed and this applies to the reservoir also. The maxim for winter watercress growing must be "maintain the water temperature."

The foregoing notes outline briefly the principle upon which modern beds are constructed. As a rule, they are laid out in a series, the whole forming a large block of beds, but any arrangement of this kind is governed by the area and configuration of the site available. If the area of beds is extensive it will be found convenient to have a central position set aside for a packing house, and at intervals between the beds sets of narrow gauge rails with flat trucks to provide rapid and labour-saving transport of the cress to the packing house.

The accompanying photographs (Figs. 1 and 2) show a good example of the construction of modern watercress beds, with a central packing shed served by light railways.

Planting and General Management.—In order to maintain a regular supply for market the cultivation of watercress calls for constant and careful attention. The beds must be planted and managed judicially to attain this end and, furthermore, the grower must maintain a supply of stock for planting up freshly prepared beds. If winter cress is grown, it will be necessary to plant up stock beds at the conclusion of the season to provide stock for planting up the following season's beds. Similarly in the case of the summer cresses, although, as a general rule, the beds are freshly planted up in the autumn to become established by the following spring.

Roughly speaking, a crop of watercress takes about four months to arrive at the marketing stage from the time of planting. Once the bed has become established and the first cut taken, it will re-grow fairly rapidly and may be cut over at frequent intervals according to the season and weather. It is not advisable, however, to leave the cress in possession of the bed too long and the latter should be cleansed, dressed and replanted at least once a year.

Beds are prepared for planting by being first thoroughly cleansed of all roots and stems of the previous crop. The beds are then "dressed" by admitting water freely, the surface of the beds being moved about thoroughly with wooden rakes so that the water can dislodge and carry away all traces of the old crop, foul mud, weeds, etc. The beds are then levelled down and firmed with the backs of the rakes. The water is reduced so that the surface is only just covered, and, when settled down, they are again ready for planting.

Planting is done by scattering a thin layer of the top growth of fully grown cress taken from the stock beds. This is done by hand, and care must be exercised to ensure an even covering

of the bed's surface. The tops used for planting should be from 12 in. to 18 in. long. In a few days these plants will make roots from every joint, and as the cress becomes established more and more water is admitted to the bed.

Great care must be taken in regulating the water supply to a newly-planted bed, or there is danger of "swimming" off the plants before they become firmly rooted.

The planting of brown winter cress usually takes place during August and September, and should be completed by Michaelmas at the latest. The planting of summer cress usually takes place in late autumn—in which case it will stand throughout the winter—or in the spring, as soon as stock becomes available. It is emphasised that the regular production of this crop demands careful thought and judgment.

Marketing the Crop.—The cutting of watercress is performed with a large sharp knife, the operator holding the cress in one hand and severing the stems with the other. The cress is usually despatched to market in wicker baskets known as flats, each holding about 70 lb. Except in the case of special trade, the cress is not bunched by the grower, but is packed into the baskets loose, care being taken, however, to keep the heads level and compact, with the stalks packed outwards.

As the crop is of a perishable nature and must be marketed in as fresh a condition as possible, cutting and despatch must take place upon the same day to ensure that the cress will be on the market not later than the following morning. If the markets are at considerable distances from the grower's district, it is often necessary to commence cutting very early in the day. Growers in the south of England commence as early as 4 or 5 a.m. to catch the following morning's markets in Manchester, Glasgow and other northern towns.

Pests.—Watercress under cultivation is often attacked in summer by the mustard beetle (*Phaedon cochleariæ*), which devours the leaves voraciously, and the damage inflicted is sometimes severe. These small beetles are of a bright blue colour and are capable of multiplying rapidly. The small yellow eggs are deposited on the under side of the leaves, and the larvæ which hatch from them likewise feed actively on the stems and leaves of the cress.

This pest passes the winter in the adult stage among rough grass and rubbish, and for this reason watercress beds constructed with turf and wood for the sides are more liable to attacks than well constructed concrete beds.

Constant watch must be maintained for this destructive pest, and if it appears it should be dealt with immediately. Limited areas of attack may be handled by clearing out and destroying the attacked cress, but in the case of extensive attacks, the better method of control is by flooding the entire bed with water for a few hours, this having the effect of sweeping away the eggs, larvæ and adults.

In districts subject to the depredations of this pest all water-courses and the sides of the beds, if no concrete work is employed, should be maintained in a clean condition, in order to reduce the chances of the beetle finding comfortable winter quarters.

A fuller description of this pest is given in the Ministry's Leaflet No. 263.

Growing watercress is also liable to damage through the depredations of the fresh water shrimp (*Grammarus pulex*), which abounds in the rivers and streams of this country. The amount of damage done depends upon the number of this small Crustacean present, and if the beds are properly cleansed and dressed at regular intervals it should never be very great. It has been found that the application of a little lime tends to keep down this pest.

* * * * * *

FIG CULTIVATION.

THE FIG (*Ficus carica*) is a native of the south of Europe, northern Africa and western Asia. It has been in cultivation since the earliest ages, and there are many records of the estimation in which the fruit was held, especially by the Greeks. The ease with which it can be propagated from cuttings, its resistance to heat and drought, its early bearing and its value as human food had in the early ages much to do with its wide dissemination.

Botanically the genus *Ficus* belongs to the order *Moraceæ*, the characteristic of which is that the flowers are borne in a pear-shaped inflorescence. Thus in the fig, the so-called fruit is really a cavernous fruit-stalk with an opening at the top; in this hollow receptacle are borne numerous minute flowers, almost filling the cavity. The latter mature into small fruits or "seeds." These flowers are of two kinds, male and female; they are very simple in structure, the male flower being composed of several stamens on a long stalk, while the female is a one-celled ovary containing a single ovule.

In one form of *F. carica* the inflorescences contain female flowers; this type is known as *Ficus*. The other type containing male flowers only is known as *Caprificus*. The latter do not produce seed, but are utilised by a small species of wasp as a receptacle in which to lay eggs, the larvæ from which take the place of the seed. Pollen is carried by the wasp from the male flowers to the female inflorescences, and fertilisation takes place. In southern Italy and other parts of Europe where the fig has been extensively grown for ages, the majority of the trees planted are *Ficus*-individuals; amongst these are grown a few of the *Caprificus* variety, by which pollination is effected by means of the wasps. It is wrong to suppose, however, that this process which is known as "caprification" is essential to the maturing of the fruit; quantities of figs come from districts where no system of caprification is employed, and it is now generally agreed that with the exception of the Smyrna or Turkish fig, in which caprification is necessary, all the common cultivated figs produce well-matured juicy fruit without any external pollination whatever.

Fig cultivation in this country is carried on largely under glass, but in the south of England, particularly in the Worthing district, the trees of bush form are often grown in the open air. The young growths are liable, however, to be killed by severe frosts, though they not infrequently spring again from the roots. Considerably more damage is done by a canker of the wood, to which outdoor figs are particularly susceptible, and which is gradually causing a reduction of the acreage of this crop.

Cultivation for Commercial Purposes.—(*a*) *Under Glass.*—Under glass figs are occasionally grown as bush trees, but the usual method is to train the trees in the form of a fan, allowing the branches to extend as far as possible. Figs will succeed in any glasshouse where there is room for expansion, but a span-roofed house is, perhaps, the best shape.

Propagation of the trees is usually made from cuttings taken from one-year-old wood and rooted in pots. For two years the young plants are kept in a sunny position, and are then ready for planting in the permanent bed in the house. These beds are prepared by removing the two spits at the top and placing in rubble to facilitate drainage, and to prevent the roots running down into the subsoil. The top soil is then replaced and the trees planted out at distances of 12 ft. apart. The trees are pruned to form a narrow fan, and the shoots trained over wires fixed at about 2 ft. below the glass roof. If bush trees are

desired the pruning and training is altered to form the right type of bush.

In the rich soils of Worthing practically no manure is given (except as a mulch to conserve the moisture), but the ground is generally limed at intervals of two or three years. Much water is needed, but it must be regulated with knowledge; the roots should not be allowed to become dry during winter, but the main waterings should be made during the growing periods. The supplies must be regulated with especial care during the ripening period, or the fruit is liable to crack.

As much light as possible is essential, and, if the foliage becomes overcrowded, a certain amount of summer pruning may be done. It is better, when adopting the "fan" method, to grow the trees in a house with glass sides, or with only a very low brick wall. A glaring light is detrimental and the houses should be shaded.

Figs will stand a considerable amount of heat, and may easily be forced; if this is done, as is generally the case at Worthing, three crops can be obtained every year. The house is started about the beginning of December and kept at a temperature of about 80 deg. F. The first crop is produced on the shoots of the past year's growth; and its success depends on the condition of this growth. It should not be soft, green or immature, but should be well hardened. If conditions are favourable, picking may commence at the end of March, and these first figs fetch the best prices in the market. The second crop is produced on the current year's growth, ripens in May and June, and produces the largest quantity of fruit, though the quality is less satisfactory. The third crop (which is sometimes removed to husband the strength of the tree) ripens in July, and usually produces abundant small fruits which fetch very little in the market.

(*b*) *In the Open.*—Figs are grown in the open at Worthing as bushes, planted from 15 to 18 ft. apart in ground which has previously been deeply cultivated and limed. The ground is kept well cultivated and free from weeds, but not liberally supplied with chemicals, for too rich a soil is not recommended. In some plantations no manure is applied; in others growers apply horse manure every year, especially when much dead wood has had to be cut out, and new growth is required. Little pruning is attempted, but dead wood and superfluous branches are removed.

The trees give two crops of figs a year, but as a rule only the first crop is taken. This crop is produced on wood of the preceding year's growth on short-jointed, well-ripened shoots.

The fruit sets in the spring and ripens in August or September. The second crop sets about August; the fruits grow to a small size, but seldom ripen.

Varieties.—The varieties of figs are exceedingly numerous in the countries where they are extensively cultivated; but many of them have not been tried in this country, and, as far as commercial fig-growing is concerned, the chief variety grown is "Brown Turkey," with "White Marseilles" as an occasional alternative.

Brown Turkey (Brown Naples, etc.).—The fruit is large, short and pear-shaped, with a grooved surface; in colour it is brown with sometimes a faint purplish tinge on the sunny side; the flesh is tinged with red at the centre and is rich and sugary. The fruit ripens early; the tree is an abundant bearer and one of the hardiest; and, while it forces well, it is also probably the best for outdoor cultivation.

White Marseilles (White Standard, etc.).—Fruit is large, roundish, and slightly ribbed; pale green in colour, becoming yellowish-white when mature; the flesh is succulent, sweet and rich. The tree ripens well against a wall and forces well.

Picking and Marketing.—The fruits are picked when nearly ripe and packed in trays holding one dozen fruits or in boxes holding four dozen. Extra special fruits are sent to market in shallow wicker "handles" containing four, laid on pink tissue paper on a bedding of wood wool. The first arrivals realise fairly high prices, but this falls as the season advances, and the final consignments realise but a small figure.

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MARCH ON THE FARM.

J. R. BOND, M.Sc.,
Agricultural Organiser for Derbyshire.

Weather Notes.—Normally March is one of the drier months of the year and is popularly regarded as windy: certainly east winds in this month have a very chilling effect. The mean temperature of the air, normally 41° to 42° F. in the Midlands, is about 2° above that of February but 4½° below that of April. The soil is ordinarily warm enough in March for the fairly quick germination of cereal grains; but seeds of certain troublesome weeds, such as charlock, usually do not begin to grow until warmer conditions return, about the middle of April.

The past winter has afforded a noteworthy illustration of the effect of temperature on germination of seed-corn. Winter oats

and wheat drilled at the beginning of November lay dormant in the soil through ten or twelve weeks of abnormally cold weather, until about the first week in February, when, as a result of eleven dry and comparatively warm days, the plant suddenly appeared above ground. One correspondent, who at the end of December despaired of a field of wheat drilled on 31st October, reported on 5th February that it had come up exceptionally well. Even heavy land that was almost sodden in the middle of January came into sowing condition during the eleven fine days ending on 5th February, and opportunists were able to disc-drill one or two fields.

Grass Land.—Since the introduction of artificial manures, the effects of which on clean-bottomed grass land are usually very pronounced, little attention has been given to the possibilities of stimulation by tillage operations. Grass land ordinarily receives little cultural treatment beyond chain harrowing at this time of the year and, in the case of meadows, rolling and stone picking a little later in the season. In some districts pastures are not even chain harrowed.

There is diversity of opinion among farmers as to whether rolling increases the yield of grass. Rolling is usually desirable to level the surface for mowing; and on light land, or where the surface has been lifted by frost, consolidation appears to have good effects. On close-textured soils, however, rolling is of doubtful service. If heavy grass land is rolled when dry, the implement may make no visible impression; while if the soil is wet at the time of the operation, growth is checked by the deficient aeration which results, and the surface may even set hard. Rolling should be avoided where the sward shows signs of insufficient aeration—*e.g.*, the absence of worm castings, the presence of moss, and an inclination to become matted; the latter may, however, on light soils be due mainly to lack of lime.

Chain harrowing to spread manurial residues and worm castings may be performed equally well with either the plain link or the spiked implement. The effect is most beneficial when the soil is fairly dry on the surface: in the case of heavy land, injury may be done by smearing if the soil is wet at the time. On grass with an inclination to become matted in the bottom with dead fibrous matter, the spiked implement can render excellent service. A severe combing admits air, warmth, light and moisture, and accelerates the processes of decay and weathering in the soil.

There are many old meadow fields on strong land with short, close herbage which yield only light crops and are very unresponsive to manurial treatment. The fact that turf slitting awakened such land was known in this country a century ago, and at various times the favourable results of scarifying operations have been reported. More recently attention has been paid to this subject on the Continent, where several firms make implements designed to cut through the turf and open the underlying soil without tearing up much of the sward. Some of these implements are harrows with blade-like teeth; others are grubbers with knife coulters in the place of tines; and one of the latter has special shares which cut narrow grooves 1¼ in. wide by 2½ in. deep, at intervals of about 12 in. The soil and turf thrown out are afterwards spread by harrowing. The work of this implement is commended by Professor Strecker, of the Leipzig Machinery Testing Station, who has made numerous experiments in the tillage of grass land. The operation is effected in autumn or early spring.

Spring Corn.—Barley commonly follows turnips folded-on, and it is a rule of good husbandry to plough close behind the sheep; further, it is generally agreed that shallow ploughing is preferable to deep work in this operation. Grassy leas, especially two-year layers, are usually sown with oats, and this land is generally ready for drilling a little before that which grew root crops in the previous season. The rate of seeding varies from 4 bushels per acre on good land in early districts to 7 or 8 on poorer soils in high-lying or late country. Heavy seeding is a mistake on dry land.

The proper rate of sowing is about 2½ million good seeds per acre. The weight of seed required to give this quantity varies according to the sample. Small-grained oats (such as Potato oat) weighing 1 ounce per 1,000 seeds, require 156 lb. (3¾ bushels) per acre; while large-grained sorts (such as Record, Crown and Victory) weighing 1½ oz. per 1,000 may need 234 lb. (5½ bushels). Some drills will not sow the latter quantity at one turn and in this connection it may be noted that the Aberdeen College experiments show a slight advantage in favour of broadcasting or cross drilling part of the seed, though this precludes horse hoeing. Where trouble from charlock may be expected, oats and barley should be drilled a little deeper than usual in order to allow of chain harrowing to destroy the weed seedlings. In the case of late-sown corn drilled deeply, much

of the charlock can be killed by chain harrowing (after rolling) before the corn is up.

Oats after lea often receive insufficient harrowing at sowing time and the land consequently lies hollow. Rolling alone is not a good means of effecting the requisite consolidation; indeed, harm is often done by rolling young corn, the effect being to restrict the necessary access of air to the soil.

Winter Corn.—Wheat and winter oats usually require attention in March. Where the soil has been lifted and loosened by frost, rolling is in order; but the harrow should follow to make a loose surface mulch. On saddened land and especially where the crop looks somewhat yellow, the proper treatment is an application of nitrate and harrowing. Even land in good condition may bear a crop which looks "perished" in spring, the various life processes in the soil being retarded by deficient aeration. As a general rule corn should not be left to go through the summer with a flat-rolled surface.

Potato Culture.—In the milder and earlier districts planting begins in March. The earlies are put in and, if progress with the sowing of spring corn allows, the second earlies are also planted. In most districts, however, April is a better month for potato setting. Apart from the incidence of late frosts, the soil is generally too cold in March for this crop to make much development.

Potatoes are regarded as a cleaning crop, and this effect generally is produced by vigorous-topped kinds, such as new seed Kerr's Pink; but second earlies do not always leave the land clean. In these, particularly when left in the ground until autumn, any perennial weeds that survive till September spread rapidly after the crop has died down.

Some farmers plant second earlies as their main crop, for the reason that these kinds complete their growth in time to escape late "blight" which may catch late varieties in full growth. Here there is perhaps some excuse for curtailing the operations of cleaning before planting. Otherwise it is better to defer setting until all "twitch" and other running weeds have been extricated, in which work the spring tooth harrow renders great help; the eradication of perennial weeds by hoeing after planting is expensive, injurious to the crop and often unsatisfactory in the end. Potatoes, unlike mangolds, are not materially prejudiced by the land having been ploughed and deeply worked near the time of planting; but with this, as with all "green" crops, undue loss of soil moisture should be avoided.

MANURES FOR MARCH.

H. V GARNER, B.A.,
Rothamsted Experimental Station.

High Grade Fertilisers.—It often happens that farmers have a choice of several alternative grades of the same class of artificial manure. High grade fertilisers save railway carriage and labour on the farm, and should certainly be chosen, in the absence of any definite reason to the contrary, if their unit prices are the same as those of the lower grades. Cases are frequent where the high grade manure is also the cheaper per unit. The following are recent values at London:—

Manure.		*Per cent.*	*Unit Value.*
Superphosphate	...	35	2/-
"	...	30	2/1
Potash Salts	...	30	2/6
"	...	20	2/7
Basic Slag	...	30	1/11
"	...	20–22	2/3

Six cwt. of 35 per cent. superphosphate contains the same amount of phosphate as 7 cwt. of the 30 per cent. grade; and 2 cwt. of 30 per cent. potash salts is the potash equivalent of 3 cwt. of the 20 per cent. salts; the economy in carriage and labour by using the higher grade fertiliser is therefore considerable.

Manures for Mangolds.—Mangolds make more demand on the soil than any farm crop, and therefore liberal treatment is necessary to obtain a good yield and keep the land in condition. Dung is the best basis for the mangold manure, and about 15 tons per acre helped out with a suitable mixture of artificial fertilisers is usually as effective as double the quantity of dung used alone.

Nitrogen is the next main requirement of the crop. This may be given as 1-2 cwt. per acre of sulphate of ammonia before drilling, or as two top dressings each of 1 cwt. per acre of nitrate of soda, one applied when the crop is singled and the other about five weeks later.

Although the dung will supply a large amount of potash, the mangold crop benefits from a further potash dressing. For this purpose the crude potash salts are especially suitable as they supply common salt in addition to the potash, which itself is purchased at the cheapest unit rate in such combination. If sulphate of ammonia is to be the source of nitrogen, 4 cwt. per acre of 12½ per cent. kainit or its equivalent of other salts would be a useful dressing. If nitrate of soda is to be used the potash might well be reduced to one half the above, unless it was known that the soil was particularly dependent on potash dressings.

Superphosphate is a suitable form in which to supply the necessary phosphate before drilling, though if the phosphate can be applied early in the year, equivalent basic slag or steamed bone flour could be used. About 4 cwt. per acre of superphosphate would be a usual dressing, but poor clays and fen soils will respond to larger applications.

Salt is sometimes used for mangolds, being applied with the nitrate of soda as a top dressing. Since, however, the potash salts will provide roughly half their weight of common salt, the need for a special application of salt is not so great now as before the general adoption of these sources of potash.

Sugar-Beet.—Increasing attention is being given to this crop, and inquiries are often made as to its manurial treatment. This is much the same as for mangolds, but since the yield per acre of beets is only about one-half that of mangolds, while more importance is attached to the quality of the roots as measured by their sugar content, the manuring of the two crops differ in minor points. Dung should be used only in moderate quantities; the heavy dressings often employed for mangolds are unnecessary; and the manure should be applied at such a time as to allow rotting to take place before the seed is sown. Fresh dung causes the roots to fang in the soil, and this is objectionable on account of the large amount of soil which has to be removed at the factory. Heavy top dressings of nitrogenous manure are to be avoided as they tend to produce coarse roots and too much leaf growth, and to delay ripening. The following is a manurial scheme suitable for ordinary loams (quantities per acre):—

10 tons dung applied in winter or as early as possible in spring.
4 cwt. superphosphate (or its equivalent of basic slag applied earlier).
½ cwt. sulphate of potash (or its equivalent of other salts).
½ cwt. sulphate of ammonia.

The above fertilisers may be mixed, broadcast, and worked in while preparing the land for drilling. When the crop is singled a top dressing of 1 cwt. per acre of nitrate of soda will be required, and about six weeks later a further dressing of the same amount may be given if the crop appears to need it.

Shortage of Dung.—Market gardeners and farmers on the outskirts of towns who rely on large quantities of town stable manure to grow vegetable crops are finding it increasingly difficult to obtain sufficient dung for their requirements. How far town stable manure could be supplemented or replaced by a mixture of artificial fertilisers for market garden crops was investigated by Dyer and Shrivell over the years 1904-13 on a rather poor

clay loam in Kent. Their results are of increasing importance as the shortage of dung becomes more acute. Some of the figures for cabbage and kindred crops have been reduced to a comparative basis and are quoted below.

Manures per acre applied each season	Autumn cut cauliflowers (13 seasons)	Broccoli (12 seasons)	Savoy cabbages (13 seasons)	Spring cabbages (12 seasons)	Brussels sprouts (12 seasons)
25 tons London dung	100	100	100	100	100
12½ „ „ „	82	87	83	92	74
12½ tons London dung + 6 cwt superphosphate + 2 cwt. nitrate of soda	103	99	102	100	95
Do. + 4 cwt. nitrate of soda	115	108	113	106	105
Do. + 6 cwt. nitrate of soda ...	121	118	113	111	110
No dung. 6 cwt. superphosphate, 8 cwt. nitrate of soda ...	98	104	105	103	93
Do, + 1 cwt. sulphate of potash	114	114	112	111	102

These yields are expressed as percentages of those obtained with 25 tons of dung per acre and are averages taken over the 12 or 13 years of experiment. The crops were not grown continuously on the same land, but were taken in rotation of market garden crops. It will be seen that 12½ tons of dung supplemented with a light dressing of artificials was about as effective as 25 tons of dung; and that each increase in the nitrate supply was reflected in the yield. The inclusion of 1 cwt. of sulphate of potash in the artificial mixture was particularly effective in the absence of dung. A complete and heavy dressing of artificials was more effective than 25 tons of dung over the 13-year period; while the mixtures of artificials with 12½ tons of dung cost less than the heavy dressing of dung and gave bigger crops. Nitrogen was supplied as nitrate of soda; phosphate as superphosphate and as basic slag in alternate years, and potash as sulphate of potash. It is probable that equivalent quantities of alternative forms of artificials (such as sulphate of ammonia, steamed bone flour, potash salts, etc.) if used in accordance with their special properties would give results of a similar character.

Potash Manures.—The less concentrated potash manures, such as kainit, potash manure salts, and sylvinite, which contain in addition to muriate of potash considerable amounts of common salt and in some cases salts of magnesia as well, are valuable

sources of potash. At this season of the year they deserve special attention as constituents of the mangold manure since the salt they contain is of special value to this crop, while the potash itself is also purchased at a relatively cheap rate. They are put on the market in various grades each guaranteed to provide a definite minimum percentage of pure potash. The best known salts contain 12½ per cent., 14 per cent., 20 per cent. and 30 per cent. of potash. The potash content must be borne in mind both in relation to the price per ton (*i.e.*, the unit value of potash in the form in question) and also in deciding how much of the particular manure to employ in a dressing. Thus, if the mangolds were to have 5 cwt. of 12½ per cent. kainit the rough equivalent of potash supplied in the other grades would be 4½ cwt. of 14 per cent., 3 cwt. of 20 per cent., or 2 cwt. of 30 per cent. salts. For crops other than mangolds and grass, where common salt is not specially required, there is something to be said in favour of purchasing the more concentrated of these salts with a view to saving railway charges and handling costs.

A Mixed Fertiliser.—Gardeners and allotment holders often require a complete artificial mixture which will serve to keep the soil in good condition as far as plant food is concerned. A suitable mixture of this kind would be:—

2 cwt.	sulphate of ammonia	providing in the mixture	5% nitrogen.
4 „	superphosphate	„ „ „	15% soluble phosphate.
1 „	steamed bone flour	„ „ „	7% insoluble phosphate.
1 „	sulphate of potash	„ „ „	6% pure potash.

The constituents could be purchased co-operatively by allotment associations and divided into small lots after thorough mixing. Applications may be made in spring at about 8 cwt. per acre or 5½ lb. per square rod to help out a light dressing of stable manure; or in the absence of dung the dressing could be increased to 12 cwt. per acre or 8 lb. per square rod. Such treatment would form a good basis for most vegetable crops, but cabbages and root crops would benefit by one or two top dressings of nitrate of soda or sulphate of ammonia at about 1 cwt. per acre or ¾ lb. per square rod in addition to the mixture. Applications of quicklime or ground limestone once every three or four years will be necessary on soils not naturally rich in chalk to obtain the best results from artificial fertilisers.

Artificial Farmyard Manure.—As a result of the recent outbreak of foot-and-mouth disease certain farmers, who have had their cattle slaughtered and are prevented from re-stocking their farms, find themselves with large quantities of straw on

hand which they cannot convert into dung. In these circumstances, and particularly if a good supply of water is available, the process of rotting straw by chemical treatment, worked out by Hutchinson and Richards at Rothamsted, might meet the case.

Results of a trial on oats with artificial farmyard manure made on a farm in Romney Marsh have recently been published by G. H. Garrad, the County Agricultural Organiser for Kent. The quantity of straw converted was 32 tons, and about three months was required for rotting to take place. The treatment and yields of oats were:—

Plot.	*Manures per acre.*	*Oats. Bus. per acre.*
1	15 tons of artificial F.Y.M. in December + artificials at sowing time ...	54
2	21 „ „ bullock dung in December (no cake fed)	46
3	15 „ „ artificial F.Y.M. in December (no artificials)	50
4	Chaffed straw in December + chemicals at sowing time (chalk and sulphate of ammonia)	34

The dressings on Plots 1 and 2 were arranged to supply the same amounts of plant food per acre. Plot 4 received such straw and chemicals per acre as would produce 15 tons of artificial farmyard manure if rotted in the stack.

The figures indicate that straw when rotted artificially under proper conditions had in this case a fertilising value which compared favourably with that of dung made without cake. That the rotting is essential is seen by the failure of Plot 4.

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending February 6th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 5	13.15	13.10	13.10	17. 5
,, ,, Lime (N. 13 per cent.)	...	...	...	12.10	19. 3
Sulphate of Ammonia, ordinary (A. 25¼ per cent.)	14. 0*	14. 0*	14. 0*	14 0.*	(N)13. 6
,, ,, ,, neutral (A. 25¾ per cent.)	15. 3*	15. 3*	15. 3*	15. 3*	(N)14. 3
Kainit (Pot. 12¼ per cent.)	...	..	...	2. 5	3. 7
,, (Pot. 14 per cent.)	2.10	2. 6	2. 5	2.10	3. 7
Sylvinite (Pot. 20 per cent.)	...	...	...	2.15	2. 9
Potash Salts (Pot. 30 per cent.)	...	...	...	3.15	2. 6
,, ,, (Pot. 20 per cent.)	...	...	...	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7. 5	7.10	7. 7	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	...	...	11. 5	11. 5	4. 8
Basic Slag (T.P. 35 per cent.)	...	...	...	3.12§	2. 1
,, ,, (T.P. 30 per cent.)	...	...	...	2.17§	1.11
,, ,, (T.P. 26 per cent.)	2.13§	2. 0§	...	...	...
,, ,, (T.P. 24 per cent.)	2. 9§	1.16§	2. 0§	...	...
,, ,, (T.P. 20-22 per cent.)	...	1.13§	..	2. 5§	2. 3
,, ,, (T.P. 18 per cent.)	2. 3§	...	1.15§	...	...
Superphosphate (S.P. 35 per cent.) ...	3.19	...	3.10§	3.10	2. 0
,, (S.P. 30 per cent.) ...	3.12	3. 7	3. 3§	3. 2	2. 1
Bone Meal (A. 4½, T.P. 45 per cent.) ...	9.10	8. 5	8.15	8. 5	...
Steamed Bone Flour (A. 1, T.P. 60 per cent.)	6.10	6. 7†	6. 5	6. 2†	...
Fish Guano (A. 9-10, T.P. 16-20 per cent.)...	12.15	...	12.10	...	...

Abbreviations: N.=Nitrogen; A.=Ammonia; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distance of different purchasers from the works.

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MONTHLY NOTES ON FEEDING STUFFS.

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The Nutritive Value of Sunflower Seed Cake and Meal.—ith the reopening of trade with Russia, a certain amount of unflower seed cake and meal is now reaching the English market, nd the writer has already had a sample submitted to him for pinion. In Russia, sunflowers are cultivated as a field crop n a fairly extensive scale. The oil is extracted and used for

culinary purposes, the residual oil cake or meal being used for cattle feeding.

Composition.—The nutritive value of sunflower seed cake varies considerably with the degree of decortication and the extent to which the oil has been extracted. A meal that has been obtained from the undecorticated seed by a solvent process is of little value as a feeding stuff, and may possess as much as 36 per cent. of woody fibre and as little as 2 per cent. of oil. On the other hand, a cold pressed cake obtained by crushing decorticated seed contains as much as 12 per cent. of oil and closely approximates to linseed cake in nutritive value. Samples of cake or meal varying between these extremes may find their way on the market, and in attempting to assess their value for feeding purposes, readers are advised to ascertain the percentage of woody fibre as well as the oil and albuminoids before purchasing. The following figures represent an average analysis of samples of decorticated and undecorticated sunflower cake respectively (per cent.):—

	Dry Matter.	*Protein.*	*Oil.*	*Soluble Carbo-hydrates.*	*Fibre.*	*Ash.*	*Digestible Nutrients.* *Prot.*	*Oil.*	*Carbo.*	*Fibre.*
Sunflower Cake, decorticated	90·4	37·4	13·8	20·4	12·1	6·7	33·6	12·2	14·6	3·6
Sunflower Cake, undecorticated	92·9	19·1	7·4	28·9	30·0	7·5	17·2	6·5	20·6	5·3

Both the above cakes represent samples obtained by the cold press method. Extracted sunflower seed meal will be still less valuable than undecorticated sunflower cake. The starch equivalent of the decorticated cake is 72.5, that of the undecorticated 49.5. The nutritive ratios are, respectively, 1 : 1 and 1 : 2.

Use of Sunflower Seed Cake for Livestock.—A typical sample of sunflower seed cake is hard in texture, and generally contains some earthy matter and weed seeds. Its keeping qualities are good, there being little danger of rancidity occurring during storage. The best samples of sunflower seed cake may be freely used with all classes of stock, but its use is not advocated for pigs, particularly fattening pigs. If pigs are fattened on a ration containing sunflower seed cake a soft quality of pork is produced. Sunflower seed cake is, however, suitable for cows, feeding to which has been followed by an increase in the fat in the milk from cows fed with it. It is also a good feeding stuff for fattening cattle and sheep, the quality of the resultant carcass being favourably influenced by its use.

In the case of working horses, it has been shown to be of value as an oat substitute.

DESCRIPTION.	Price per Qr. s. d.	lbs.	Price per Cwt. s. d.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. £	Price per lb. Starch Equiv. d.
Wheat, British	—	—	11/-	11 0	0 16	10 4	71·6	2/10	1·52
Barley, British Feeding	—	—	10/6	10 10	0 12	9 18	71	2/9	1·47
" Canadian No. 4 Western	37/6	400	10/6	10 10	0 12	9 18	71	2/9	1·47
Oats, English, White	—	—	11/-	11 0	0 14	10 6	59·5	3/6	1·87
" " Black and Grey	—	—	9/8	9 13	0 14	8 19	59·5	3/-	1·61
" Scotch, White	—	—	11/4	11 7	0 14	10 13	59·5	3/7	1·92
" Canadian No. 2 Western	28/0	320	9/10	9 17	0 14	9 3	59·5	3/1	1·65
" " No. 3 "	26/9	"	9/4	9 7	0 14	8 13	59·5	2/11	1·56
" Canadian Feed	25/0	"	8/9	8 15	0 14	8 1	59·5	2/8	1·43
" Argentine	24/0	"	8/5	8 8	0 14	7 14	59·5	2/7	1·38
Maize, American	43/3	480	10/2	10 3†	0 13	9 10	81	2/4	1·25
" Argentine	45/0	"	10/6	10 10	0 13	9 17	81	2/5	1·29
" South African	43/3	"	10/2	10 3†	0 13	9 10	81	2/4	1·25
Beans, English Winter	—	—	11/-	11 0	1 13	9 7	67	2/9	1·47
" Rangoon	—	—	8/9	8 15†	1 13	7 2	67	2/1	1·12
Peas, Japanese	—	—	24/	24 5†	1 9	22 16	69	6/7	3·53
Millers' Offals:—									
Bran, British	—	—	—	7 17	1 7	6 10	45	2/11	1·56
" Broad	—	—	—	8 15	1 7	7 8	45	3/3	1·74
Middlings Fine (Imported)	—	—	—	10 2	1 3	8 19	72	2/6	1·34
" Coarse (British)	—	—	—	9 2	1 3	7 19	64	2/6	1·34
Meal, Barley	—	—	—	11 7	0 12	10 15	71	3/0	1·61
" Maize	—	—	—	11 5	0 13	10 12	81	2/7	1·38
" " South African	—	—	—	10 5	0 13	9 12	81	2/4	1·25
" " Germ	—	—	—	10 5	0 19	9 6	85·3	2/2	1·16
" " Gluten-feed	—	—	—	9 5	1 8	7 17	75·6	2/1	1·12
" Locust Bean	—	—	—	8 5	0 10	7 15	71·4	2/2	1·16
" Bean	—	—	—	12 15	1 13	11 2	67	3/4	1·78
" Fish	—	—	—	20 0	4 8	15 12	53	5/11	3·17
Linseed	—	—	—	23 10	1 12	21 18	119	3/8	1·96
" Cake, English 9% Oil	—	—	—	13 7	1 19	11 8	74	3/1	1·65
CottonseedCake,English 5¼% Oil	—	—	—	7 15	1 16	5 19	42	2/10	1·52
" " Egyptian 5¼% Oil	—	—	—	7 12	1 16	5 16	42	2/9	1·47
Decorticated Cotton Seed Meal 7% Oil	—	—	—	13 7	2 16	10 11	71	3/0	1·61
Coconut Cake 6% Oil	—	—	—	10 2	1 11	8 11	73	2/4	1·25
Palm Kernel Meal 2% Oil	—	—	—	6 10	1 5	5 5	71·3	1/6	0·80
Feeding Treacle	—	—	—	7 0	0 8	6 12	51	2/7	1·38
Brewers' Grains:—									
Dried Ale	—	—	—	8 7	1 5	7 2	49	2/11	1·56
" Porter	—	—	—	7 17	1 5	6 12	49	2/8	1·43
Wet Ale	—	—	—	1 15	0 9	1 6	15	1/9	0·94
" Porter	—	—	—	1 10	0 9	1 1	15	1/5	0·76
Malt Culms	—	—	—	7 12	1 15	5 17	43	2/9	1·47

† At Liverpool.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of January and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, suppose coconut cake is offered locally at £10 per ton. Its manurial value is £1 11s. per ton. The food value per ton is therefore £8 9s. per ton. Dividing this figure by 73, the starch equivalent of coconut cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 13s. 6d.; P_2O_5, 4s. 1d.; K_2O, 2s. 6d

Quantities to use.—Fattening cattle have been given up to 14 lb. per head per day, pigs 2-4 lb. a day, fattening sheep 3 oz., and working horses may be given up to 6 lb. per head per day. The quantities here given refer to the best quality cake; much more care should be exercised in feeding the undecorticated cake or extracted meals. Since the digestibility decreases rapidly with the increase in woody fibre the undecorticated samples are relatively less valuable as feeding stuffs than the decorticated samples, on a comparative analytical basis.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·25	2 4	71·6	8 7	0 16	9 3
Oats	1·25	2 4	59·5	6 19	0 14	7 13
Barley	1·25	2 4	71·0	8 6	0 12	8 18
Potatoes	1·25	2 4	18·0	2 2	0 4	2 6
Swedes	1·25	2 4	7·0	0 16	0 2	0 18
Mangolds	1·25	2 4	6·0	0 14	0 3	0 17
Good Meadow Hay	1·56	2 11	31·0	4 10	0 14	5 4
Good Oat Straw	1·56	2 11	17·0	2 10	0 7	2 17
Good Clover Hay	1·56	2 11	32·0	4 13	1 1	5 14
Vetch and Oat Silage	1·43	2 8	14·0	1 17	0 7	2 4

* * * * * *

Poultry Breeding Experiments.

THE Ministry has now received Treasury authority to carry out at the Reaseheath School of Agriculture, Nantwich, Cheshire, practical experiments in the breeding of laying poultry with a view to obtaining information as to the effect, if any, upon the inheritance of laying qualities of certain forms of in-breeding and out-breeding practised at present by North of England breeders. Details of these experiments are as follows:—

1. To test experimentally the effect of *in-breeding* on fecundity in certain selected strains of pure-bred fowls, by mating together brother and sister, dam and son, sire and daughter, dam and grandson, etc., the relative fecundity of the progeny to be carefully recorded.
2. To test the effect of *out-breeding* on fecundity in certain selected strains of pure-bred fowls.
3. Concurrently with experiments 1 and 2, to make observations on the strains employed, in order to obtain evidence on the question whether there is or is not a linkage between the external characters and fecundity.
4. Concurrently with experiments 1 and 2, to record any data bearing on the possibility of building up a strain of pullet breeders.

These experiments will constitute part of the National Poultry Institute Scheme, and a Sub-Committee of the Ministry's Poultry Institute Advisory Committee is responsible for the carrying on of the experiments. The members of the Sub-Committee were nominated by the National Poultry Council and consist mainly of practical poultry breeders, with Professor S. J. Hickson, M.A., D.Sc., F.R.S., of Manchester University as chairman.

The Sub-Committee proposes to use as a foundation stock, breeding pens of 6 hens and 1 cockerel of each of the following three breeds, viz., White Leghorn, Rhode Island Red and White Wyandotte, wtih the provision of a duplicate pen in each case. The hens in each pen will consist of three good layers and three poor layers whose breeding and individual trap-nest records are known.

For the purpose of the experiments, the Cheshire County Council will provide land at the Reaseheath Farm Institute, and other facilities, free of charge, and the work will be conducted in close association with the staff of the Cheshire Education Authority.

The capital expenditure involved under the Scheme up to the 31st March next is estimated at £1,500. This figure covers the cost of a portable bungalow for the resident poultryman, a food store, incubating house and office, as well as the poultry houses and equipment required up to that date. The capital expenditure for the ensuing twelve months up to the 31st March, 1925, is estimated at £800. One-fourth of the capital expenditure will be provided out of the funds contributed by the poultry industry towards the National Poultry Institute Scheme, the remaining three-fourths being provided by the Ministry of Agriculture out of the Development Fund. Maintenance expenditure, mainly on feeding stuffs, wages and fuel, is estimated for the twelve months ending 31st March, 1925, at £715. The whole cost of maintenance will be borne by the Development Fund.

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Instruction in Milk Recording.

ARRANGEMENTS have been made with the authorities of the Midland Agricultural College to hold a course of instruction in Milk Recording, from 28th April to 17th May, 1924, provided that a sufficient number of students apply for admission. A syllabus showing full particulars of the course may be obtained on application to the Principal, Midland Agricultural

College, Sutton Bonington, Loughborough. The course includes lectures on milk—its nature and composition, bacteria and their relation to milk, testing of milk, and the principles and practice of milk recording; and practical work on actual milk recording of a comprehensive character, including food records, cost of foods, and cost of food per gallon of milk. The tuition fee will be £3 3s. Board may be obtained at the Sutton Bonington Hostel (30s. per week). The registration fee for the period is 5s.

Application for admittance to the course should be made on or before 18th April. Preference will be given to students who are either already milk recorders under the Ministry's scheme or who intend to apply for such posts. It is not possible to give any indication as to what vacancies for milk recorders may arise, nor can any guarantee be given that students will in fact obtain employment as milk recorders. The names of successful students will, however, be circulated by the Ministry to all milk recording societies in order that preference may be given by societies to these students on the occasion of filling a vacancy. The appointments carry salaries ranging usually from £150 to £250 per annum, and they afford to young agriculturists an excellent opportunity of acquiring a practical knowledge of dairy farming, often of the best type, as carried out on a variety of farms.

* * * * * *

Trials of Potatoes for Immunity from Wart Disease, 1923.*

THE trials which are conducted by the Ministry each year with the object of testing new varieties of potatoes as to their immunity from wart disease were again carried out in 1923 on the farm of the National Institute of Agricultural Botany, at Ormskirk, Lancashire. The actual field operations and the taking of records were carried out by Mr. Harold Bryan, B.Sc., and Miss Whitehead, of the Institute, but the trials were conducted on a plan approved by the Ministry.

The results of the trials have been considered by a small Committee composed of representatives of the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland.

The findings of the Potato Synonym Committee of the

* For the results of the 1922 trials, see this *Journal*, March, 1923, p. 1134.

National Institute of Agricultural Botany have been accepted where recommendations as to the classification of varieties as synonymous with existing varieties have been made by that Committee.

After full consideration of the results of the 1923 trials, 18 new varieties have been added to the list of those approved as immune from wart disease, and descriptions of these varieties are appended hereto. In addition to those included in this list 31 varieties successfully passed the test; the growers, however, do not propose to place these varieties on the market at the present time, and their inclusion in the approved list is therefore postponed with the object of restricting the list to those varieties which have actually been introduced into commerce.

New Approved Immune Varieties.—The following are the descriptions of those varieties of potatoes which have been added to the Ministry's list of varieties, approved as immune from wart disease as the result of the 1923 trials:—

Early Varieties:—

Balcarres.

Tubers—round; skin white; flesh white, eyes medium.
Haulm—upright, strong, vigorous, medium height, leaflets medium size, medium green; stems green; wings knife-edged. Leaf very open.
Flowers—white; anthers dark yellow.

Second Early Varieties:—

The Massie.

Tubers—round; skin white; flesh deep yellow; eyes medium.
Haulm—erect to spreading, irregular; leaflets light yellow green, narrow, elongated; stems light green; wings slightly serrated.
Flowers—white.

Wild Rose.

Tubers—oval, flat; white skin; shallow eyes, white flesh.
Haulm—spreading; leaflets light yellow green, glossy, heart shaped; stem bronzed; wings much serrated.
Flowers—white with bluish tint, very distinct; anthers orange.

Late or Maincrop Varieties:—

Avondale.

Tubers—kidney; skin white; flesh pale lemon; eyes shallow.
Haulm—tall, upright, vigorous; leaflets small, dull; stems much bronzed, numerous; wings serrated; leaf open.
Flowers—white; anthers yellow.

Beauty of Bute.

Tubers—round; skin white, speckled pink specially in the eyes, ping blush at heel end of tuber; eyes medium to deep; flesh white.

Haulm—tall, erect to spreading; leaflets glossy, medium green, corrugated; leaf open; stem much bronzed; wings straight.
Flowers—heliotrope, tipped white.

Kenalt.
Tubers—round; skin white; traces of pink in the eyes; flesh lemon; eyes shallow.
Haulm—upright, regular, vigorous; leaflets grey-green; flat; stems green, serrated wings; open leaf.
Flowers—none observed, buds drop.

Buchan Beauty.
Tubers—round, dented at stem end; skin yellow with blue purple splashes; flesh yellow; eyes deep; sprouts blue purple.
Haulm—tall, upright; stems thick, branching freely, mottled blue purple especially at base; leaf open; midrib often has a spot of purple at the base and at the base of the leaflet stalk; leaflets small, round, medium to dark green, margins fluted, veins well marked, giving the leaflet a slightly crinkled appearance; secondary leaflets small, but fairly numerous.
Flowers—dark blue purple tipped white, profuse.

Dundarave.
Tubers—kidney to oval; skin white; flesh pale lemon; eyes shallow.
Haulm—spreading; leaflets light green, glossy, flat.
Flowers—creamy white, numerous.

Early Manistee.
Tubers—oval, flattish; skin uniformly red; eyes shallow and on the point; flesh white.
Haulm—bushy, somewhat spreading; leaflets small, dull, corrugated, rigid; leaf open; stem light green; wings serrated.
Flowers—white.

Edinchip.
Tubers—kidney to oval; skin white; flesh pale lemon; eyes shallow.
Haulm—spreading; leaflets light green, glossy flat.
Flowers—white, very seldom formed.

Footprint.
Tubers—round, skin white; flesh pale lemon; eyes shallow.
Haulm—upright.
Flowers—white, anthers orange.

Golden Marvel.
Tubers—oval, skin white; flesh yellow; shallow eyes.
Haulm—upright, strong, tall; leaflets dark, glossy, cup-shaped; stems bronzed, stout; wings slightly serrated.
Flowers—white with blue blush.

Keay's Champion.
Tubers—oval, skin white mottled pink, especially in heel; flesh pale lemon; eyes medium.
Haulm—spreading; leaflets light green, soft, heart shaped; numerous green stems; wings straight.
Flowers—white; anthers orange.

Liddesdale Lad.
Tubers—oval; skin pink; sprouts pink; flesh pale yellow; eyes saucer-shaped and on the point.

Haulm—habit tall; stem branching, markedly pink, with green wings. Leaf open, with pink midrib. Leaflet dull, dark green and hairy; bases of young leaflets markedly red-purple when young; veins well marked; stalks red purple.
Flowers—white, profuse; buds red purple; stalks short and red purple; berries profuse.

Main's Surprise.
Tubers—oval; skin white; flesh pale lemon; eyes shallow.
Haulm—upright, medium height; leaflets medium size, elongated; stems very slightly bronzed; wings slightly serrated.
Flowers—white, rare, buds dropping.

Royal Stewart.
Tubers—kidney; skin white; flesh white; eyes shallow.
Haulm—upright, strong; leaflets light green, heart shaped, crinkled; stems stout, bronzing in the axils of the leaves; leaf open.
Flowers—white, small.

Scottish Chief.
Tubers—round; skin white; flesh white, eyes shallow.
Haulm—upright; leaflets medium green, crinkled, cup shaped; stem slight bronzing; wings markedly serrated.
Flowers—white, rare.

Spion Cop.
Tubers—round; skin white; flesh lemon; eyes medium.
Haulm—upright, bushy; leaflets medium green, elongated, glossy, crinkled; stems numerous; wings straight.
Flowers—white, rare.

Note.—The variety "Clifden Seedling" added to the list after the 1922 trials (see this *Journal*, March, 1923, p. 1137) has now been declared by the Potato Synonym Committee of the National Institute of Agricultural Botany to be synonymous with "Champion II," under which name it will in future be shown in the Ministry's list.

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Sheep Breeding Research.

A REPORT* on wool improvement has been published by the British Research Association for the Woollen and Worsted Industries, "Torridon," Headingley, Leeds. It is issued by the Joint Committee on Sheep Breeding which consists of representatives of the Association, the Universities of Leeds, Edinburgh and North Wales, the University College, Reading, Armstrong College, Newcastle-upon-Tyne, sheep breeders, and the Agricultural Departments of England, Scotland and Ireland.

The report describes a scheme for wool improvement which was proposed by the University College of North Wales, and is being carried out in close co-operation between the College

* Publication No. 29.

and the Animal Breeding Research Department, Edinburgh, where a farm for breeding operations will be taken. Microscopic examination has been made of the various types of fibres, and the development of the fleece is being watched from birth to maturity with a close regard for manufacturers' requirements. Particular attention is being given to conditions which promote or destroy "kemp" or "red kemp" in different flocks, while a number of cross breeding experiments are in progress.

The results of the first miscroscopical study of fleeces were published in the *Journal of the Textile Institute*, Vol. 13, No. 7, 1922; those of the second and third are given in the present report. They deal with the wild variety and with the adult Blackface fleece.

A number of rams and ewes of pure Merino blood have been given by the State Farms of Peru, and experiments in breeding this type are being conducted. A large range of Merino stud sheep fleece samples have been obtained from Australia and are being examined, and comparative tests with existing sheep-marking materials are also being conducted.

The work of the Committee is of great interest to both breeders and manufacturers, and the Report deserves the closest attention of all interested.

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Allotments Advisory Committee.

THE Minister of Agriculture has appointed Mr. Walter R. Smith, M.P., Parliamentary Secretary to the Ministry, to be Chairman of the Allotments Advisory Committee. This Committee was set up on the recommendation of the Departmental Committee on Allotments which reported in 1922, and that it is in the nature of a Standing Committee consisting of representatives of the Central Land Owners' Association, the Parliamentary Allotments Committee, the County Councils' Association, the Association of Municipal Corporations, the Urban District Councils' Association, the Land Union, the Agricultural Organisation Society, and the National Union of Allotment-Holders, which advises the Ministry upon allotment matters.

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Foot-and-Mouth Disease.—*Committee of Investigation.*—The Minister has decided to appoint a small Committee to examine into the circumstances of the recent outbreak of foot-and-mouth disease, to review and report upon the slaughter policy and the procedure

adopted by the Ministry, to advise whether any further precautions should be taken to guard against the introduction and spread of the disease, and to consider whether a scheme of insurance can be devised as an alternative to the existing system of compensation for slaughtered animals.

The Committee will consist of the Right Hon. E. G. Pretyman (Chairman), Mr. Walter Smith, M.P., Parliamentary Secretary to the Ministry of Agriculture, Mr. H. German, and Mr. Alexander Batchelor.

Position on 21st February, 1923.—The position in regard to foot-and-mouth disease has remained stationary during February. The outbreaks during the first four days of the week ended 23rd February, however, show a tendency to an increase. It will be remembered that the disease reached its height in December, when 1,261 premises were found to be infected. The figures of outbreaks for the last eight weeks are 319, 256, 193, 115, 57, 57, 63, and 55 respectively. New centres of disease have, however, appeared during February in Essex, Ayr, Notts, Hunts, and Kent.

Since the commencement of the present series of outbreaks on the 27th August, 1923, the numbers of infected premises declared and animals slaughtered and the expenditure incurred up to 21st February have been:—

Total number of outbreaks in Great Britain - - - - -				2,664
Number of counties affected - - -		35 in England 2 in Wales and 11 in Scotland		
Total number of animals slaughtered or authorised to be slaughtered - -	Cattle. 90,940	Sheep. 30,797	Pigs. 42,454	Goats. 115
Percentage of animals slaughtered to total animal population of Great Britain - - - - -	Cattle. 1·3	Sheep. 0·15		Pigs. 1·5
Estimated Gross Compensation payable for animals slaughtered - - -		£2,901,000		
Estimated receipts for salvage of healthy carcases -		£383,600		

On the 8th February the Ministry issued an Order operating as from the 13th February, the effect of which was materially to reduce the extent of the areas subject to restrictions. Some important amendments have been made in the regulations controlling the movement of animals in infected areas, viz.:—

(1) Animals which are moved from one farm to another in an infected area or from premises outside any infected area to premises in such an area, otherwise than for breeding purposes, are required on arrival at the place of destination to be detained thereon for a period of 28 days;

(2) For the purposes of licensing movements or of authorising the holding of sales of animals whether at fat stock markets

or on farm premises, any infected place may be disregarded at the expiration of 28 days from the date upon which the slaughter of all stock thereon was completed, provided that in the meantime the final disinfection of the premises has been completed to the satisfaction of an Inspector of the Ministry; and

(3) In the case of sales of animals on farm premises the Local Authority may authorise sales on any such premises which are not within 2 miles of an infected place instead of within 5 miles. The distance of 5 miles is still applicable in the case of fat stock markets.

Sale of Seeds other than Cereals.—The Seeds Act, 1920, makes it compulsory in the case of a sale of any of the principal kinds of grass, clover, field or garden seeds for the seller to state in writing certain essential particulars as to their quality, such as the percentage of germination, percentage of purity, presence of injurious weed seeds, country of origin, etc. Similarly, in the case of a sale of seed potatoes, particulars must be given as to the country of origin, variety and size.

These particulars must be delivered to the purchaser at or before the time of sale or delivery of the seed, except in the case of wheat, oats, rye and barley for seed, when, by virtue of a general licence issued by the Ministry of Agriculture, the necessary particulars may be delivered at any time within one month of the sale.

Paragraphs have appeared in the Press which suggest that the general licence authorising delay in the delivery of the particulars applies to all classes of seed covered by the Act. It should, however, be clearly understood that it relates solely to the cereal seeds mentioned above.

Seed Potatoes: Regulations for Sale.—The Ministry has prepared a memorandum which gives, in a very concise form, the particulars that are required by the Seeds Act, 1920, the Seeds Regulations, 1922, and the Wart Disease of Potatoes Order, 1923, to be declared in respect of sales of seed potatoes. This memorandum is being widely circulated and will, it is believed, prove of assistance to sellers of seed potatoes when the spring sales commence. Copies may be obtained from the Ministry, 10, Whitehall Place, London, S.W.1.

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NOTICES OF BOOKS.

The Manuring of Grass Land for Hay.—(Winifred E. Brenchley, D.Sc. London: Longmans, Green & Co., price 12s. 6d.) Is one of the series of Rothamsted Monographs on Agricultural Science. In 1856 Lawes and Gilbert laid out the Park Grass Plots to determine the relative effect of different combinations of manures upon hay production with reference not only to yield but to the botanical composition of the herbage, and they eventually published the results of 20 years' continuous manuring. Dr. Brenchley has collated the additional data which have accumulated since then, and by dint of compression and tabulation of masses of facts and figures has succeeded in presenting the salient features in an interesting and highly instructive form.

The authoress is careful to point out that the results deal solely with the Rothamsted plots on heavy soil and that, with certain exceptions, the same manuring has been applied to each plot up to the present day; further, that the first crop of grass has been cut for hay every year, and, since 1872, the aftermath as well. While, therefore, from the scientific point of view, the value of the work lies to a great extent on the length of time over which the experiments have been carried on, farmers must take into consideration the fact that the continuous use of the same manures and of the same method of crop utilisation is not in accord with general practice. What the farmer will want to know is whether, in the ordinary way, it will be possible to attain the most desirable combination of plants.

Of the more striking results set out, one of the most interesting is the beneficial effect on Meadow Foxtail—a very early and valuable grass—of a plentiful supply of nutrients. It seems to need abundance of nitrogen, either in "artificial" or organic form, in a soil not too acid from lack of lime. As regards *Agrostis* (Bent, Twitch, etc.) it is found not to be encouraged by superphosphate nor by heavy dressings of nitrogenous manures with minerals, and is actively discouraged by liming. On the other hand, it is encouraged by organic manures.

Of the few leguminous plants found in the herbage, it is stated that Red Clover and Birdsfoot Trefoil are most in evidence under starved conditions and where minerals have been used—a finding not in disaccord with everyday experience.

Farmers as well as academic workers should find much food for thought in this admirably arranged and skilfully summarised record of experimental work.

Kohlensäure und Pflanzenwachstum.—(Bornemann. F. 2nd Edition, pp. 138. Berlin: Paul Parey, 1923.) This is a second edition of a book originally published in 1919. The writer points out in the preface how the three intervening years have tended to confirm the arguments of the earlier edition. No one now doubts, he says, that cultivated plants give higher yields when they receive an increased supply of carbon dioxide. A few of the old opponents still fight a rearguard action with the contention that it is impossible to provide this increased supply of carbon dioxide to crops in the open field. The book covers the whole question of the assimilation of carbon dioxide frm air, soil and manure, and an account is given of experiments with increased supply, both in plant houses and in the open air.

The Potato.—(William Stuart. Philadelphia and London: J. B. Lippincott Company. 518 pp. Price 12s. 6d. net.)—In the preparation of this book it has been the aim of the author to discuss the basic principles underlying the production of potatoes, as well as to include the latest available information in regard to the American potato industry as a whole. Chapters are included dealing with the original potato of South America, the history of its introduction and spread in Europe, and finally its introduction into the United States from Ireland in the eighteenth century.

Though this volume deals primarily with potato growing in the United States, and cannot fully apply in this country, where conditions are materially different, yet the fundamental principles underlying production are the same. It can be recommended to all agriculture students in this country.

The author has long been a well-known authority on potato breeding and potato selection, and in Chapter xxi he gives the results of his experience and conclusions as only a master of his subject can give.

Perhaps, however, the chapter on classification will be the most appreciated by European readers, because of the detailed and thorough way in which the descriptions of each commercial variety has been dealt with and illustrated with coloured plates showing sprouted tubers and blossoms.

The whole book is abundantly illustrated with photographs and text figures.

Grassland Farming.—(W. J. Malden. London: Ernest Benn, Ltd., 1924. 30s. net) appears opportunely at a time when the question of grass versus arable is seriously engaging the attention of British farmers.

The book deals with the principles of pasture-making, both temporary and permanent; choice of seeds; seeding conditions; subsequent care and management in respect of both hay and grazing; hay-making; ensilage; and seed-growing. It concludes with a short chapter on the breaking up of pasture, and an appendix devoted mainly to the work of seed firms and the mixtures of seeds recommended by them for different soils and climates.

In his treatment of the subject the author takes an independent line, and is perhaps rather inclined to exaggerate the difference between his own views and those of other grass experts. Many, however, may be disposed to agree with him that as a result of isolated experiments undue prominence has sometimes been given to basic slag and wild white clover as the universal means for improving or making a pasture, and that unwarrantable deductions have been made from the effects induced by the continuous cake-feeding of one class of stock on land naturally poor and lacking in phosphates.

On the other hand, the author would seem to cling too rigidly to the ancient dogma of "lean years" following the first flush of herbage in the formation of a permanent pasture. He makes out a case, however, for a more general recognition of the value of nitrogen and humus in pasture improvement, and indicates the need for a proper balance of the several food ingredients required by plants. In his advocacy of humus he might, with advantage, have differentiated between "a deep turf of roots" and a turf of matted fibres.

The chapters on the management of permanent pasture and on haymaking are essentially practical and useful. In the latter a warning is given against the not uncommon practice of judging of the suitability of the manurial dressings from the recorded weights of hay, regardless of the constituent species. In his methods of sowing Mr. Malden finds a place for the drill as well as for the broadcasting machine, and he might even have gone so far as to suggest that, in certain circumstances, the disc drill is about the only sure means of securing an adequate covering of the seed. For the destruction of ant-hills he has nothing more effective nor economical to suggest than the spade or plough. Has he never tried heavy drag harrows?

In his choice of seed-mixtures, Mr. Malden favours the so-called "safe" plan of including a little of many species regardless of the factor of competition. It is unfortunate that the mixture selected by the author as a basis for prescriptions in general contains no perennial rye-grass.

Sound advice is given on renovation, and the hopelessness of obtaining profitable results from merely sowing away poor land to grass is sufficiently indicated.

The book contains much useful information gleaned from observation and experience, but it suffers somewhat from its great length and needless reiteration.

In a volume of this quality certain obvious errors are unfortunate, such as the wrong labelling of a very good illustration of Meadow Foxtail as Meadow Fescue (p. 228), and the statement that present-day basic slag only contains 15 per cent. of phosphoric acid.

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Ainsworth-Davis, J. R.—The Principles of Agriculture. (275 pp.) London: Methuen & Co., 1924, 7s. net. [63(022).]

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